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MEMORANDUM**

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**TOXIC SUBSTANCES ALERT PROGRAM**  
(Revised)

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TOXIC SUBSTANCES ALERT PROGRAM\*  
(Revised)

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INTRODUCTION

Many toxic substances are procured and used at the Lewis Research Center. In my review of procurement records covering a  $3\frac{1}{2}$  year period ending June 1977, I found 480 procurements of the 187 toxic substances described in this report. These toxic substances are not hazardous to personnel if they are used, stored, and disposed of properly.

The various health and safety offices at the Lewis Research Center are concerned that toxic substances be handled, used, stored, and disposed of in such a manner that they do not present a hazard to personnel or to the public. A method for quickly determining where and by whom such substances are used is desired for industrial hygiene and personnel safety considerations. In addition, one should know the location and use identification should such substances be placed under restriction by agencies such as OSHA or EPA. It would also be helpful as a ready reference base against which less toxic substances might be substituted. One of several programs in effect in controlling the potential hazards of toxic substances is the Toxic Substances Alert Program.

Through this program we determine when toxic substances are procured, alert the users that such substances may present hazards if not properly controlled, and notify the Environmental Health Office, the Office of Occupational Medicine, and the Safety Office of the procurement, this is accomplished by a monthly review of the procurement records for potential toxic substances. When toxic substances are found that may present a hazard if not properly controlled, I issue a Toxic Substances Alert to the initiator of the Purchase Request with copies to the three offices noted above. I also prepare and attach a one-page description of the toxic characteristics of the substance (see below). The Alert is sent only once to the user. It is then his responsibility, through consultation with the Safety Office and/or the Environmental Health Office, to ensure that the proper industrial hygiene and safety controls are effected. However, records are kept of subsequent repeat procurements.

The fact that an Alert is issued does not mean that the substance is unsafe. However, the substance has the potential for presenting hazards if proper controls are not put into effect. An evaluation of the degree and duration of exposure, the physical characteristics of the substance, the conditions of exposure, and the presence of other

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\*This report is a revised version of the similarly titled NASA TM X-71711.

toxic substances in the work area should be made. Proper ventilation, housekeeping, protective clothing, and work techniques normally permit safe use.

At the time of this writing, I have reviewed procurement records over a 42-month period, researched approximately 550 substances to determine toxicity levels, and issued 390 Alerts covering 187 toxic substances to 128 staff members. The variety of chemicals procured is probably typical of the range of toxic substances normally found at LeRC since it covers 3½ years of procurement history. Continued review should result in many additional Alerts.

The National Institute for Occupational Safety and Health (NIOSH) 1975 Toxic Substances List contains 17 000 chemical substances which are deemed toxic under certain conditions of exposure, of which 1545 are potential or known producers of cancer or tumors. Of the 187 toxic substances described in this report, 27 (or 15 percent) are known or suspected carcinogens. Its current estimate of the number of unique toxic substances for which toxic effect information may eventually be available is 100 000. At the present time, only toxic chemicals in their relatively pure state are covered in this program. Not included are trade name products representing compounded or formulated proprietary mixtures available as commercial products. It is very difficult to assess the toxicity of trade name products since the components are often unknown and not revealed by the manufacturer. In addition, the formulations change from time to time with substitution of different chemicals with differing toxicities, and the contribution to the total toxic effect by each component is difficult to evaluate. Examples of such products used at LeRC are solvents, paints and thinners, cleaners, lubricants, sealing compounds, and aerosol products.

My records presently permit retrieval of the following information relative to toxic substances on-site:

(a) Procurements of toxic substances since November, 1973, within the limitations discussed above.

(b) Who procured these substances, the amounts, and usually where used.

(c) The variety of toxic substances acquired since November, 1973, that any individual user has had in his possession.

(d) A list of recently procured commercial products which should be investigated as to toxicity as proprietary information becomes available.

This document updates NASA TM X-71711 issued in April, 1975, and includes a compilation of toxic chemicals procured at the Lewis Research Center since November, 1973. For each toxic substance, I have provided a description, toxicity elements and treatment.



This updated version adds information on personnel protection, control of spills, disposal of waste material, chemicals forming unsafe conditions, and relative fire hazard of the substances.

## ACETANILIDE

Chemical Formula:  $C_6H_5NH(COCH_3)$

Synonyms: acetanil; acetic acid anilide; acetaminobenzene;  
acetylaniline; antifebrin; N-phenylacetamide

Description: A white, shining, crystalline powder or leaflet which is odorless. It has a slightly burning taste.

Fire Hazard: It is combustible with a flash point of  $174^{\circ}C$  ( $345^{\circ}F$ ).  
Fire extinguishants: water,  $CO_2$ , or dry chemical

Toxicity: Acetanilide is toxic by inhalation, ingestion, or by skin contact, although it has medicinal uses. Toxic doses stimulate the central nervous system, damage the kidneys and prevent proper blood oxygenation, resulting in oxygen deficiencies in the tissues and interfering with respiration.

Ingestion - One gram has toxic effect including gastrointestinal disturbance, renal failure, and nervous disorder; 6 grams has been reported to cause death.

Skin - In addition to being absorbed through the intact skin, acetanilide can produce dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with plenty of running water

Skin - Wash immediately for 10 to 15 minutes with soap and running water. Rinse thoroughly. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage using water, followed by cathartics and enema.

\*General - Since acetanilide produces methemoglobinemia, administer 1 percent methylene blue by IV, 1 to 2 mg/kg of body weight. Administer oxygen and artificial respiration as required. Provide stimulants as indicated and sedation if necessary.

Personnel Protection: Wear plastic or rubber laboratory coat, safety glasses, and butyl rubber gloves. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Absorb liquids on paper towels. Place in fume hood and allow to evaporate to dryness. Cover solids with sand and soda ash mix (90-10). Mix and shovel into cardboard box. Wash spill site with strong soap solution.

Disposal: Burn at approved burning site. Stay upwind of fire.

Chemical Incompatibility: Aromatic hydrocarbons in general form unsafe combinations with inorganic acids, halogens, and molten sulfur.

## ACETIC ACID

Chemical Formula:  $\text{CH}_3\text{COOH}$

Synonyms: ethanoic acid; ethylic acid; vinegar acid; methane-carboxylic acid

Description: A colorless, clear, corrosive liquid with a pungent, sour odor. Vinegar is 4 to 12 percent acetic acid. Odor is detectable at 1 ppm.

Fire Hazard: A moderate fire hazard; lower limit of flammability is 4 percent in air, with a flash point of  $40^\circ\text{C}$  ( $104^\circ\text{F}$ ). When heated to decomposition, it emits toxic fumes and fully burns to water and carbon dioxide. The ignition temperature is  $426^\circ\text{C}$ .  
Fire extinguishants: water, alcohol foam,  $\text{CO}_2$ , or dry chemical.

Toxicity: Health problems can result from inhalation of vapors, ingestion, or contact with the body. It acts as an irritant in all three modes.

Inhalation - Exposures to vapors should not exceed 10 parts per million parts of air (ppm) averaged over an eight-hour work period. 200-500 ppm of glacial acetic acid (100 percent concentration) causes extreme nose, throat, and lung irritation.

Ingestion - Swallowing the concentrated acid produces a burning taste, pain in the abdomen (which can last several days or weeks), labored breathing, vomiting, cardiovascular collapse, and death.

Skin and eye contact - Contact with concentrations greater than 50 percent to the eye can cause severe burns, conjunctivitis, and corneal erosion. Skin burns, ulcers, dermatitis, and blackening of the skin can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage with limewater, followed by demulcents. Do not induce vomiting.

\*Inhalation - Oxygen therapy and rest. Symptomatic and supportive treatment follows.

Personnel Protection: Wear rubber gloves, chemical goggles or plastic face shield, laboratory coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., during clean-up of spills, wear self-contained breathing apparatus with full-face mask, or organic vapor canister mask.

Spill Control: Eliminate any sources of ignition. Cover spill with soda ash or sodium bicarbonate. Mix and add water if necessary. Scoop

up neutral slurry (litmus test) and wash down drain with excess water. Wash spill site with soda ash solution.

**Storage:** Separate from oxidizing materials and combustibles.

**Disposal:** See spill control above for small quantities. Larger quantities can be burned at an approved disposal site.

**Chemical Incompatibility:** Dangerous in contact with chromic acid, hydroxyl compounds, ethylene glycol, perchloric acid, permanganates, peroxides, nitric acid, or other oxidizing materials. In general, organic acids can form unsafe combinations with inorganic acids, caustics, amines, aldehydes, esters, cyanohydrins, nitriles, and ammonia.

## ACETIC ANHYDRIDE

Chemical Formula:  $(\text{CH}_3\text{CO})_2\text{O}$

Synonyms: acetic oxide; ethanoic anhydride; ethanoic anhydrate; acetyl oxide

Description: A colorless liquid with pungent acid odor.

Fire Hazard: Flammable. Flash point is  $54^\circ\text{C}$  ( $129^\circ\text{F}$ ); explosive from 2.7 to 10.1 percent by volume. When heated to decomposition, it gives off toxic fumes. It can react violently with water or steam. Vapor may explode if ignited in an enclosed area. Extinguish fire with water, dry chemical, alcohol foam, or  $\text{CO}_2$ .

Toxicity: Acetic anhydride is a severe irritant. It can cause severe eye burns and injury to the cornea. The vapor is corrosive, especially to the eyes and upper respiratory tract.

Inhalation - Exposure to airborne vapors should not exceed five parts per million parts of air (ppm) averaged over an 8-hour period. Injury deep in the lungs can occur through hydrolysis.

Skin - Contact with the skin causes dermatitis and white necrosis of tissue. Severe burns and blisters have been reported.

Eyes - As both the liquid and vapor it can cause severe damage to the eyes. If not treated, corneal opacity may result.

Ingestion - It is slightly toxic by mouth; the liquid can produce serious internal burns.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items below marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with plenty of water promptly

Skin - Wash with soap and water promptly. Remove contaminated clothing and shoes (\*) Treat skin burns in the usual manner.

\*Ingestion - Gastric lavage followed by saline catharsis and demulcents. Do not induce vomiting.

\*Inhalation of vapors - oxygen and rest.

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or plastic face shield, and laboratory coat. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus with full-face mask, or organic vapor-acid gas canister mask.

Spill Control: Eliminate any sources of ignition. Cover spill with soda ash or sodium bicarbonate. Mix and add water if necessary. Scoop up neutral slurry (litmus test) and wash down drain with excess water. Wash spill site with soda ash solution.

Disposal: See spill control above for small quantities. Larger quantities can be burned at an approved disposal site.

**Chemical Incompatibility:** Acetic anhydride can form unsafe combinations with inorganic acids, caustics, amines, alcohols, glycols, ethers, esters, nitriles, ammonia, and cyanohydrins.



## ACETONE

Chemical Formula:  $\text{CH}_3\text{COCH}_3$

Synonyms: propanone; methyl ketone; ketone propane; pyroacetic ether; dimethyl ketone; beta-ketopropane; methylacetal

Description: A water-clear liquid with a fragrant to pungent odor detectable at from 2 to 100 ppm.

Fire Hazard: Flash point at  $-18^\circ\text{C}$  ( $0^\circ\text{F}$ ); explosive from 2.55 to 12.8 percent by volume in air. Highly flammable. Flash-back along vapor trail may occur. Extinguish fires with dry chemical, alcohol foam, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: Inhalation is the most likely health hazard but ingestion and eye and skin contact are also potential problems.

Inhalation - Acetone is highly volatile and in high concentrations acts as a narcotic. Exposure to airborne concentrations of the vapors should not exceed 1000 parts of vapor per million parts of air (ppm) averaged over an eight-hour work period; 200 to 500 ppm is irritating to the eyes but some workers have tolerated over 5000 ppm for up to an hour, so eye irritation cannot be relied on to indicate a safe concentration.

Ingestion - Swallowing small quantities can produce narcosis, and injury to the kidneys and liver.

Skin and eye contact - Repeated skin contact results in irritation and dermatitis from acetone's de-fatting action. Eye contact can damage the eye by corneal erosion.

### Treatment of Overexposure:

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid. Contact Medical Services immediately.

Eyes - Irrigate with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Gastric lavage followed by salt water and saline catharsis. Rest, oxygen, and low fat diet.

\*Inhalation - Remove promptly to fresh air. Administer oxygen (and artificial respiration if necessary).

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, lab coat and rubber apron. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear chemical cartridge respirator.

Spill Control: Eliminate any sources of ignition. Absorb liquid on paper towels and allow to evaporate within a fume hood.

Storage: Eliminate all sources of ignition.

**Disposal:** Small amounts may be washed carefully down the lab drain, diluting with plenty of cold water. Make sure there are no flames in the vicinity. Larger amounts (greater than one liter) may be burned in 500 ml portions at an approved disposal area.

**Chemical Incompatibility:** Acetone can form unsafe combinations with inorganic acids, caustics, amines, hydrogen peroxide, and aldehydes.



## ACETOPHENONE

Chemical Formula:  $C_6H_5COCH_3$

Synonyms: phenyl methyl ketone; hypnone; acetylbenzene; benzoyl methide; methyl phenyl ketone

Description: A colorless liquid with a sweet pungent odor and pleasant taste.

Fire Hazard: Combustible. Flash point  $82^{\circ}C$  ( $180^{\circ}F$ ). Extinguish fires with water spray, foam, dry chemical or  $CO_2$ .

Toxicity: Acetophenone is toxic by inhalation, ingestion, and on skin contact. It is a narcotic in high concentrations and a central nervous system depressant.

Inhalation - Exposure to the vapors should not exceed a suggested limit of 20 parts per million parts of air (ppm). Inhalation exposure is normally no problem unless the liquid is heated. The vapors are irritating to the nose and throat.

Ingestion - The level of toxicity by ingestion is low to moderate.

Skin and eye contact - Absorption through the skin is not expected to occur. Prolonged or persistent contact causes dermatitis. Eye contact produces marked irritation and temporary injury to the cornea.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Further medical treatment is generally supportive and symptomatic. For ingestion, dilute by drinking milk or water.

Personnel Protection: Wear rubber gloves, chemical goggles, and rubber lab coat. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear chemical cartridge respirator.

Spill Control: Eliminate all sources of ignition. Absorb liquid with paper towels. Evaporate to dryness in a lab fume hood.

Disposal: See spill control above for small quantities. Larger quantities can be burned at an approved disposal site.

Chemical Incompatibility: Acetophenone can form unsafe combinations with inorganic acids, caustics, amines, and aldehydes.

## ACETYL CHLORIDE

Chemical Formula:  $\text{CH}_3\text{COCl}$

Synonyms: ethanoyl chloride; acetic acid, chloride

Description: A fuming, colorless liquid with a pungent odor. In normal storage may deteriorate and generate hazardous fumes.

Fire Hazard: Dangerous when exposed to heat or flame. When heated to decomposition emits highly toxic phosgene fumes. Flammable. Flash point  $4.4^\circ\text{C}$  ( $40^\circ\text{F}$ ). Extinguish fires with dry chemical or carbon dioxide. Reacts violently with water.

Toxicity: Highly toxic by inhalation, and by eye contact. On contact with moisture it readily hydrolyzes to form hydrochloric acid and acetic acid. When heated to decomposition it emits highly toxic fumes of phosgene.

Inhalation - Exposure to airborne vapors should not exceed a suggested limit of five parts per million parts of air averaged over an 8-hour work period. Concentrated vapors are highly corrosive to the respiratory tract.

Ingestion - Destruction of the mucous membrane results. The estimated lethal dose is 1 gram.

Skin and eye contact - It is highly hazardous on contact with the eyes and skin. It can cause burns to the cornea of the eye.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes. Get medical attention.

Skin - Wash with plenty of water for 15 minutes. Do not attempt to neutralize with alkalies since this will generate heat and add to the distress. Remove contaminated clothing and shoes.

\*Ingestion - Avoid lavage or emetics. Administer by mouth diluants such as water, and neutralizers such as milk of magnesium in large quantities, followed by demulcents such as milk or olive oil.

\*General - Opiates to relieve pain. Subsequent treatment is symptomatic and supportive, with bed rest.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield and lab coat. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill and Disposal Control: Cover spill with sodium bicarbonate. For small spills scoop the mixture into a large beaker of water, let

stand a few minutes and slowly pour into a drain with large amounts of water. For large spills, scoop into a plastic-lined container, spread on ground in open area and flood with water. Wash site of spill with soapy water.

**Storage:** Keep away from water. Store in well-ventilated, cool, dry location.

**Chemical Incompatibility:** Acetyl chloride reacts violently with water or lower aliphatic alcohols. It can form unsafe combinations with dimethyl sulfoxide, inorganic acids, amines, and caustics.

## N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE

Chemical Formula:  $\text{C}_6\text{H}_5\text{CH}_2\text{N}(\text{CH}_3)_2\text{NH}_3\text{Cl}$

Synonyms: ammonium alkyldimethyl benzyl chloride; beniol; benzalkonium chloride; BTC; zephirin chloride; cequartyl; drapoline; marinol; rodalon; osvan; zephiral

Description: A clear, mobile liquid most widely used as a germicide

Toxicity: The toxicity is not well established but several fatalities are ascribed to ingestion of between 100 and 700 milligrams per kilogram of body weight. Systemic poisoning can injure the heart, liver, and kidneys, depress the central nervous system, cause circulatory shock, convulsions, and asphyxial death.

Inhalation - The vapors are irritating to the mucous membrane and can produce pulmonary edema.

Ingestion - A 10 to 15 percent solution can cause destruction of mucous membrane, severe corrosion and gastro-intestinal ulceration and hemorrhaging.

Skin and eye contact - Irritating to the skin and eyes

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not intended for first aid action.

Eyes - Flush promptly with water

Skin - Wash promptly with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Swallow large quantities of milk or egg whites; omit gastric lavage. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Absorb liquid on paper towels or vermiculite. Place in fume hood and evaporate to dryness. Wash the spill site with soap solution.

Disposal: Pour onto vermiculite, sodium bicarbonate, or sand-soda ash mixture (90-10). Mix and shovel into cardboard box. Burn at approved disposal site. Stay up-wind.



## ALUMINUM BROMIDE

**Chemical Formula:**  $\text{AlBr}_3$

**Description:** White to yellowish-red lumps

**Fire Hazard:** When strongly heated, it produces highly toxic fumes. Reacts with water to emit hydrogen bromide fumes. Use dry chemical or foam on adjacent fires.

**Toxicity:** It may be toxic by inhalation, ingestion, or skin contact. The primary route of industrial poisoning is by inhalation. As for most bromides, the primary effect is on the central nervous system producing mental depression, and in severe cases, mental deterioration.

Inhalation - No permissible level of airborne concentration has been established. Avoid breathing the fumes or vapors.

Ingestion - Ingestion of as little as one ounce can produce coma and death. Prolonged exposure to low quantities can cause skin rash and emaciation.

Skin and eye contact - It is irritating to the eyes, skin, and mucous membrane. It acts as an astringent, hardening and tanning the skin and producing dermatitis.

**Treatment of Overexposure:** Contact Medical Services immediately.

NOTE: This section is for the information of medical personnel and is not to be considered first aid. Systematic poisoning should be treated by hydration and mild water diuresis. Further treatment is described in the literature.

**Personnel Protection:** Wear rubber gloves, chemical goggles, and lab coat. Use in fume hood.

**Spill Control:** Cover spill with excess sodium bicarbonate. Scoop the mixture into a large beaker of water and let stand a few minutes. Slowly pour into a drain with a large amount of water. (For large amounts scoop into a plastic-lined container; spread on the ground at an approved disposal site and flood with water, or incinerate.) Wash the site of the spill with soapy water.

**Storage:** Preserve under tightly closed cap.

**Chemical Incompatibility:** The inorganic halides can form unsafe combinations with inorganic acids, caustics, amines, olefins, cyanohydrins, and sodium and potassium.

## ALUMINUM CHLORIDE

Chemical Formula:  $\text{AlCl}_3$

Synonyms: aluminum trichloride; trichloroaluminum

Description: Grayish-white or yellowish solid crystals or powder with an acid, irritating odor. Fumes in air.

Fire Hazard: Reacts violently with water to generate hydrogen chloride gas. Extinguish fires with foam or dry chemical.

Toxicity: Highly toxic by ingestion or inhalation.

Ingestion - Corrosive to tissue if in anhydrous form (similar to the action of alum). A lethal dose is believed to be about 10 grams.

Skin Contact - It is an astringent and can harden and crack the skin. It may also act as a skin sensitizer.

Treatment of Overexposure: Contact Medical Services

Eye and Skin Contact - Flush immediately with large amount of water. Remove contaminated clothing and shoes. Contact ophthalmologist if eyes were involved.

Ingestion - Drink milk or water. Do not induce vomiting.

Personnel Protection: Wear chemical goggles and rubber protective clothing. If powder becomes airborne in excess of safe levels, e.g., during clean-up of a spill, wear self-contained breathing apparatus.

Spill Control: Cover spill with excess sodium bicarbonate. Scoop small amounts into a large beaker of water and let it stand for a few minutes. Slowly pour into a drain with large excess of water. If it is a large quantity, scoop the bicarbonate mix into a plastic bag or box and burn at an approved disposal site. Or spread on the ground and flood with water. Wash the spill site with soapy water.

Storage: Store in a cool, dry area. Protect from direct sunlight.

Disposal: After long storage in closed containers an explosion may occur when the container is opened. The powder can be mixed with sodium bicarbonate (see above) or it can be left to weather at an approved disposal site.

Chemical Incompatibility: Dangerous in contact with water, strong alkaline materials, or fumes of ammonia.

## ALUMINUM OXIDE

Chemical Formula:  $\text{Al}_2\text{O}_3$

Synonym: alumina; alundrum

Description: A white powder, balls or lumps. Noncombustible.

Toxicity: Short-term exposure to high concentrations of alumina dust presents a slight inhalation hazard. Long-term exposure to lower concentrations presents a moderate toxicity hazard. The degree of inhalation toxicity remains controversial, but particle size seems to be a larger factor; the finer the particles, the greater the toxicity hazard. The recommended limit of exposure to airborne dust is 5 milligrams per cubic meter of air.

Finely divided (less than 1 micron) particles of alumina are thought to be capable of causing lung damage, e.g., fibrosis. Animal studies have shown lung tumor resulting from alumina dust exposure.

There is no toxicity associated with swallowing alumina dust or with skin contact.

Personnel Protection: Provide adequate room and local exhaust ventilation to maintain dust levels below the recommended airborne limit of exposure. Maintain good housekeeping. Wear thick gloves and safety glasses.

Chemical Incompatibility: Aluminum oxide may react violently with chlorine trifluoride and may cause ethylene oxide to polymerize violently.

Disposal: Use landfill site.

## AMMONIA

Chemical Formula:  $\text{NH}_3$

Description: A colorless gas or liquid with a sharp, intensely irritating odor. Odor detectable as low as one to five parts of vapor per million parts of air (ppm).

Fire Hazard: A moderate fire hazard, flammable from 16 to 25 percent by volume, with an ignition temperature of  $649^\circ \text{C}$  ( $1204^\circ \text{F}$ ). Presence of oil or other combustible materials will increase the fire hazard. Do not use water to fight fire except to knock down vapors. Cut off gas flow or use chemical foam or dry chemicals. Wear self-contained breathing apparatus.

Toxicity: Ammonia is highly toxic and irritating by ingestion, inhalation, and contact.

Inhalation - Exposure to the airborne vapor should not exceed 50 ppm averaged over an eight-hour work period. 125 ppm is irritating; the maximum tolerance level for one-half to one hour is 300 to 500 ppm; 5000 ppm can be fatal due to bronchial spasm or pulmonary edema.

Skin and Eyes - Ammonia is an alkali and skin contact can produce first and second degree burns; contact with the eyes can produce burns and corneal ulcers.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush immediately with plenty of cool water for at least 15 minutes. (\*) Follow by irrigation with normal saline solution, then refer to an ophthalmologist.

Skin - Wash with plenty of water and soap. Remove contaminated clothing and shoes.

\*Ingestion - Give fruit juice or vinegar by mouth. Treat esophageal stricture.

\*Inhalation - Administer intermittent positive pressure oxygen therapy, codeine for cough, decongestants, bronchodilators and cortisone. Further treatment is supportive and symptomatic. Watch for pulmonary edema and complications leading to pneumonia.

Personnel Protection: For liquefied ammonia wear rubber gloves, chemical goggles and face shield, lab coat, rubber apron and boots. When adequate vapor control is not possible, e.g., spills, wear self-contained breathing apparatus, or an ammonia-canister full face mask.

Spill Control: Dilute with water slowly, neutralize with  $\text{HCl}$ , and discharge to the sewer with a large excess of water.



Storage: Outdoor or detached storage is preferred. Store in cool, well-ventilated noncombustible location away from sources of ignition. Separate from other chemicals. Protect from direct sunlight and sources of percussion.

Disposal: See spill control, above.

Chemical Incompatibility: Ammonia can form unsafe combinations with acetaldehyde, acrolein, acids, ketones, phenols, esters, boron, bromine, chlorine, chlorites, fluorine, gold, cyanohydrins, iodine, mercury, chlorates, potassium, powdered metals, nitrites, sulfur, or silver oxide.

# AMMONIUM CHROMATE

Chemical Formula:  $(\text{NH}_4)_2\text{CrO}_4$

Description: Yellow crystals. May explode when shocked or heated.

Toxicity: Highly toxic by ingestion or inhalation; a strong irritant. It is a recognized carcinogen.

Inhalation - Exposure to the airborne dust should not exceed a suggested limit of 0.1 milligrams per cubic meter of air, averaged over an 8-hour work period.

Treatment of Overexposure: Contact Medical Services.

Eyes - Flush the eyes with water for at least 15 minutes.

Skin - Wash with soap and water. Remove clothing and launder before re-use.

## AMMONIUM FLUORIDE

Chemical Formula:  $\text{NH}_4\text{F}$

Description: A white crystal which decomposes by heat.

Toxicity: In addition to being highly irritating to tissues, ammonium fluoride is a protoplasmic poison, and is highly toxic. Overdoses produce cardiovascular collapse, oxygen starvation in the tissues, and shallow respiration. Chronic exposures may cause calcification of ligaments and tendons.

Inhalation - Exposure to airborne dust or vapors should not exceed a suggested limit of 2.5 milligrams per cubic meter of air averaged over an 8-hour work period.

Skin - There is no absorption through the intact skin.

Ingestion - Swallowing this toxic material is the primary mode of exposure.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes and skin contact - Wash with water

\*Ingestion - Administer gentle gastric lavage using lime water or 1 percent solution of calcium chloride, followed by swallowing several ounces of lime water at frequent intervals. Inject by IV 10 ml of 10 percent solution of calcium gluconate. Repeat injection in 1 hour. Further details of treatment are available in the literature.

\*General - Treat acidosis with IV sodium bicarbonate or by gastric intubation.

Personnel Protection: Wear rubber gloves, chemical goggles, and laboratory coat.

Spill Control: Cover solutions with soda ash, mix and scoop into a beaker of water. Neutralize with 6M hydrochloric acid and wash down the drain with excess water. Collect solids in a beaker, dissolve in a large amount of water; add soda ash and treat as above.

Chemical Incompatibility: Ammonium fluoride can form unsafe combinations with ammonium nitrate and potassium chlorate.

## AMMONIUM HYDROXIDE

Chemical Formula:  $\text{NH}_4\text{OH}$

Synonyms: aqua ammonia; water of ammonium; ammonium hydrate; aqueous ammonia

Description: A colorless liquid

Toxicity:  $\text{NH}_4\text{OH}$  is corrosive to tissues on contact and especially dangerous to the eyes. It is not a systemic poison. It is moderately dangerous by contact and inhalation and is highly dangerous when ingested.

Inhalation - Exposure to airborne vapors or mists should not exceed a suggested limit of 50 parts per million parts of air (ppm) averaged over an 8-hour period. Concentrations of 2500 to 6500 ppm are dangerous after 30 minutes and 5000 to 10 000 ppm are rapidly fatal. Lung edema and pneumonitis can result.

Skin and eye contact - Even low concentrations are extremely irritating to skin and eyes. Contact with the eyes, even though if not painful initially, can result in blindness if prompt first aid action is not taken.

Ingestion - Swallowing  $\text{NH}_4\text{OH}$  causes damage to esophagus and stomach, often after a delayed time. As little as 3 ounces can cause death due to circulatory shock, asphyxia from throat edema, or infection.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush immediately with plenty of water for 15 minutes, even if no pain is experienced. (\*) Obtain the services of an ophthalmologist.

Skin - Wash with soap and water. Remove contaminated clothing and shoes. (\*) Treat burns as any thermal burn is treated.

Ingestion - Drink large quantities of water or weak acids such as orange juice or dilute vinegar. (\*) Lavage and emetics are contraindicated. Administer demulcents.

\*Inhalation - Administer intermittent positive pressure oxygen. Codein for cough, bronchodilators and decongestants as indicated. Additional treatment is supportive and symptomatic.

Personnel Protection: Avoid contact with liquid or vapor. Wear rubber gloves, chemical goggles, and laboratory coat. When adequate vapor control is not possible, such as in spills, wear a self-contained breathing apparatus or ammonia-canister mask.

Spill Control: Sweep up solid form, dilute with water in a large beaker, and neutralize (litmus paper) with 6M hydrochloric acid.

Wash down the drain with a large amount of excess water. Neutralize spilled solutions and mop up. Discharge to sewer with large excess of water.

Storage: Do not fill bottles to the brim. Store in cool place.

Disposal: Small quantities can be diluted with sufficient water to render it safe for pouring to a drain, either with or without neutralizing with dilute mineral acid.

Chemical Incompatibility: Ammonium hydroxide can form unsafe combinations with acetaldehydes, acrolein, acids, ketones, phenols, esters, halides, silver nitrate, gold and aqua regia, oleum, silver oxide, and silver permanganate.

## AMMONIUM PERSULFATE

Chemical Formula:  $(\text{NH}_4)_2\text{S}_2\text{O}_8$

Synonyms: Peroxydisulfuric acid, diammonium salt; ammonium peroxydisulfate

Description: A white crystal or granular powder; odorless.

Fire Hazard: Moderate, by chemical reaction with reducing agents, producing oxygen. When heated to decomposition ( $120^\circ\text{C}$ ), it emits highly toxic fumes of sulfur oxides. With water it emits hydrogen peroxide or ozone.

Toxicity: It is toxic primarily by absorption through inhalation; may produce rhinitis (Baker's asthma), or nasal inflammation. No permanent effects result after termination of exposure. No airborne threshold limit values have been established.  
Treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat.

Spill Control: Cover with a reducer (hypo, a bisulfate, or a ferrous salt - but not carbon, sulfur, or strong reducing agents). Mix well and spray with water. With sulfite or ferrous salt some 3M sulfuric acid may be needed to speed up the reaction. Scoop the slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash spill site thoroughly with a soap solution.

Storage: Keep containers closed, protect from water, and store in a cool, dark location.

Chemical Incompatibility: Ammonium persulfate can form unsafe combinations with aluminum powder and water (explosion) and with sodium peroxide if crushed in a mortar, heated, or exposed to a stream of carbon dioxide. Dangerous with chlorates, perchloric acids, metal dusts, organic materials, or sulfur.

## AMMONIUM THIOCYANATE

Chemical Formula:  $\text{NH}_4\text{SCN}$

Synonyms: Ammonium sulfocyanate; weedazol; ammonium rhodanide

Description: Colorless solid; used as insecticide and herbicide.

Fire Hazard: When heated to decomposition ( $170^\circ \text{C}$ ) it emits highly toxic fumes of cyanides

Toxicity: Very toxic when swallowed; toxicity effects are low when mists or powders are inhaled; absorption through the intact skin is not thought to be a problem. Systemic poisoning affects the central nervous system causing delirium, convulsions, dizziness and circulatory collapse. Fifteen to 30 milligrams ingested at one time has caused death within 10 to 48 hours.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel only and are not first aid action items.

Eyes - Flush with water

Skin - Wash with soap and water. Remove and launder contaminated clothing.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Administer oxygen, if necessary. Administer hemodialysis, if indicated. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat.

Spill Control: Cover solutions with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M hydrochloric acid and wash down the drain with excess water. Collect solid spills in a beaker, dissolve in a larger amount of water, add soda ash, mix and treat as above.

Storage: Keep containers closed.

Chemical Incompatibility: Ammonium thiocyanate can form an explosive combination when reacted with lead nitrate.

## AMYL ACETATE

Chemical Formula:  $\text{CH}_3\text{COOC}_5\text{H}_{11}$

Synonyms: pear oil; banana oil; amyl acetic ether; pentyl acetate; pentanol acetate; n-amyl ester.

Description: A colorless to yellow liquid having a fruity, banana odor. There are three isomers; iso-, n-, and sec-. The odor is detectable at about 1 to 7 ppm depending upon grade.

Fire Hazard: Dangerous when exposed to heat. When heated, emits acrid fumes. Limits of explosive mixture with air range from 1.1 to 7.5 percent. The flash point for n-amyl acetate is 25° C (77° F). Extinguish fire with alcohol foam,  $\text{CO}_2$ , or dry chemicals.

Toxicity: In high concentration it irritates the mucous membrane, depresses the central nervous system, and is narcotic.

Inhalation - Exposure to airborne vapors should not exceed 100 parts per million parts of air (ppm) averaged over the 8-hour work period. 1000 ppm causes physical distress, and 5000 ppm for 30 minutes can cause deep narcosis. Damage to kidney, liver, and lung can occur.

Ingestion - The same symptoms described above occur, in addition to possible damage to the gastro-intestinal tract.

Skin and eye contact - Irritating to the eyes. Has a defatting action on the skin resulting in dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Subsequent treatment is symptomatic and supportive in nature.

Personnel Protection: Wear rubber gloves, chemical goggles, or face shield, and lab coat. When adequate vapor control is not possible, such as in spills, respiratory protection should be worn: organic vapor chemical cartridge respirator for less than 1000 ppm; self-contained breathing apparatus for greater than 1000 ppm.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill on paper towels. Evaporate to dryness in a fume hood.

Storage: Store in a cool, well-ventilated area. Ground metal storage containers.

Chemical Incompatibility: Amyl acetate can form unsafe combinations with inorganic acids, caustics, amines, ammonia, and halogens.



## N-AMYL ALCOHOL

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_4\text{OH}$

Synonyms: pentyl alcohol; 1-pentanol; n-butylcarbinol; pentan-1-ol; fusel oil

Description: Amyl alcohol has eight isomers; n-amyl alcohol is one of four primary isomers. It is a colorless liquid with a mild, sweet odor.

Fire Hazard: It is a moderate fire hazard when exposed to heat. It has a flash point of 38° C and a lower limit of flammability of 1.2 percent. The vapors may explode if ignited in an enclosed area. Extinguish fires with dry chemicals, alcohol foam, or  $\text{CO}_2$ . Water may be ineffective on fires.

Toxicity: Amyl alcohol is the most toxic of the commonly used alcohols. It acts as a narcotic and central nervous system depressant. Exposure to airborne vapors should not exceed a suggested 100 parts per million parts of air.

Inhalation - It is irritating to the nose and throat as a vapor or liquid. It can produce kidney or liver damage, pulmonary edema, and coma.

Ingestion - The most toxic route of exposure is swallowing the liquid. Small quantities can cause delirium, coma, and reportedly death by cardiac arrest.

Skin and eye contact - It is irritating to the skin and eyes as a vapor or liquid.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water

Skin - Wash with water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage with copious water followed by mineral oil. Caffeine sodium benzoate, 0.5 gram subcutaneous; additional treatment may be found in the literature.

\*Inhalation - Artificial respiration and oxygen, as necessary.

\*General - Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. When adequate vapor control is not possible, e.g., in spills, wear the appropriate chemical cartridge respirator or a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper towels and evaporate to dryness in a fume hood.

Disposal: Small quantities may be diluted with water and poured to a drain. Large quantities may be burned at an approved disposal site.

**Chemical Incompatibility:** Amyl alcohol can form unsafe combinations with inorganic acids, aldehydes, esters, alkylene oxides, halogens, and acid anhydrides. It can be decomposed by hydrogen trisulfide with explosive violence.

## ANILINE HYDROCHLORIDE

Chemical Formula:  $C_6H_5NH_2HCl$

Synonyms: benzenamine hydrochloride; aniline salt; aniline chloride

Description: White crystals; water soluble

Fire Hazard: Moderate; flash point is 193° C (380° F); when heated to decomposition emits highly toxic fumes. Extinguish fires using water alcohol foam,  $CO_2$ , or dry chemical.

Toxicity: Toxic either by ingestion, or inhalation of dust or vapors. Induces cyanosis by reducing the capability of the blood to carry oxygen, and depresses the central nervous system. Sufficiently high exposures can lead to a stupor, cardiovascular collapse, and death. Prolonged exposure to low concentrations can result in liver damage. It is not toxic by direct absorption through the skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Flush with running water

Skin - Wash with soap and running water.

\*Ingestion - Administer gastric lavage with water, followed by saline cathartic.

\*General - Administer oxygen and artificial respiration, if necessary. Administration of 1 percent methylene blue orally or intravenously is recommended for cyanotic condition (greater than 50 percent methemoglobin).

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. Handle within a fume hood whenever possible.

Spill Control: Cover with sodium bicarbonate. Scoop the mixture into a large beaker of water and let stand for a few minutes. Slowly pour into a drain with plenty of water.

Disposal: For small quantities follow the spill control procedure. For larger quantities, scoop into a cardboard container and burn in an approved disposal area (or spread on disposal area grounds and flood with water).

## ANISOLE

Chemical Formula:  $C_6H_5OCH_3$

Synonyms: methylphenylether; methoxybenzene; phenyl methyl ether

Description: A colorless liquid with an aromatic odor

Fire Hazard: Flammable; flash point  $52^{\circ} C$  ( $125^{\circ} F$ ). Extinguish fires with  $CO_2$ , foam, or dry chemical.

Toxicity: Anisole is highly toxic by inhalation and a moderate ingestion and skin absorption hazard. There is little information in the literature relative to the effects of anisole exposure or the medical treatment.

Contact Medical Services if you may have been exposed to anisole in significant amounts either by inhalation of vapors, swallowing the liquid, or contact with the skin.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. When adequate vapor control is not possible, such as in spills, wear a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill with paper towels and evaporate to dryness in a fume hood.

Chemical Incompatibility: Anisole can form unsafe combinations with inorganic acids, esters, halogens, and elemental phosphorus.

### 1,8,9-ANTHRACENETRIOL

Chemical Formula:  $C_{14}H_{10}O_3$

Synonyms: anthralene; anthralin; 1,8-dihydroxyanthranol; cignolin; dithranol; anthranol

Description: A odorless, tasteless yellow powder. Combustible.

Toxicity: Anthralin is considered to be a poison, having moderate toxicity by ingestion, inhalation, and absorption through the intact skin. Excessive exposure has produced skin irritation and injury to the kidneys. More importantly, it is capable of forming tumors and is considered to be a carcinogen.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Sweep onto paper and burn in an authorized disposal area.

## ANTIMONY PENTOXIDE

Chemical Formula:  $\text{Sb}_2\text{O}_5$

Synonyms: antimonie anhydride; antimonie oxide; stibic anhydride;  
antimonie acid

Description: A white or yellowish powder having a moderate fire risk.  
It is an oxidizing material.

Toxicity: It is highly toxic by inhalation of dusts or by ingestion.  
As a systematic poison it parallels arsenic. Acute heavy poisoning can cause death by respiratory or circulatory failure. Liver damage and heart muscle damage can occur.

Inhalation - Exposure to airborne dust should not exceed a suggested limit of 1320 micrograms per cubic meter of air averaged over an 8-hour work period. It is irritating to the upper respiratory tract and can produce pneumonitis.

Ingestion - It is slowly absorbed into the circulatory system, lowering the white blood cell count and poisoning the body. Irritation of the gastro-intestinal system also occurs.

Skin - There is no absorption through the intact skin. However, dermatitis and scarring of the skin has occurred.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes and skin contact - Flush with water

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Additional treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. Work in a fume hood. If spilled outside fume hood wear appropriate chemical cartridge respirator while cleaning up.

Spill Control: Collect in a beaker. Dissolve in a large amount of water. Add soda ash, neutralize with 6M hydrochloric acid, and wash down the drain with excess water.



## ARSINE

Chemical Formula:  $\text{AsH}_3$

Synonyms: arsenic hydride; arseniuretted hydrogen; hydrogen arsenide

Description: A colorless gas with a mild garlic odor. A military poison gas.

Fire Hazard: A moderate fire hazard; when exposed to flame it emits highly toxic fumes of arsenic.

Toxicity: Arsine presents a high toxic hazard by inhalation due to its affinity for hemoglobin in the red blood cells. Exposures to air-borne concentrations should not exceed 0.05 parts per million parts of air (ppm) averaged over the 8-hour work period. 6 to 10 ppm is the maximum concentration that can be inhaled for 1 hour without serious consequences, and 300 ppm for 5-10 minutes can be fatal. Arsine combines with the hemoglobin in the red blood cells and destroys the cells, producing anemia. It can also cause kidney and liver damage. Death can result from chemical asphyxia due to anemia, or to pulmonary edema caused from lung irritation, or circulatory failure.

Arsine is not toxic due to contact with the skin or eyes.

Recent studies show an apparent correlation between inorganic arsenic compounds and certain lung and lymphatic cancers.

Treatment of Overexposure: Immediately contact Medical Services.

No first aid actions other than removal from the source of the arsine is available. The following information is for the attention of medical personnel, not for first aid purposes:

Administer artificial respiration and oxygen, if necessary.

Transfusion of whole blood and packed RBC, if indicated.

Administer 4 mg/Kg of body weight of dimercaprol (but not to exceed 300 mg in a single dose) every 4 hours the first day; every 6 hours the second day; and then three times daily for a week.

Further treatment is supportive and symptomatic. Complete bed rest.

Personnel Protection: No food or smoking in the working area. Shower and change clothes before eating and going home. Wear rubber gloves, safety glasses, and lab coat. Work in a fume hood when possible or use process enclosures. When gas concentrations may exceed safe limits, e.g., during a leak, wear self-contained breathing apparatus.

Storage: Store in a well-ventilated area clear of combustible materials.

Leak Control and Disposal: Dilute with inert gas and place in a fume hood for ventilation. Seal container and return to supplier when possible.

Chemical Incompatibility: Arsine bubbled through chlorine produces flames; mixed with nitric acid it reacts explosively.

## ASBESTOS DUST

**Chemical Composition:** A mixture of magnesium and iron silicates in fibrous form. The primary mineral forms are chrysotile (white color), amosite (brown), crocidolite (blue), and anthophyllite (white).

**Synonyms:** amianthus; amphibole; earth flax; mountain cork; serpentine; stone flax

**Description:** Flax-like fibers, white, grey, green, or brown; fire-proof.

**Toxicity:** Asbestos presents a serious inhalation hazard which on prolonged exposure (4-20 yr) produces lung fibrosis, asbestosis, impaired oxygen transfer, and in some cases cancer of the lung, pleura, and peritoneum. Asbestos dust is not a health hazard when swallowed or in contact with the skin. Lung fibrosis can be nondisabling for years before it progresses to a serious health problem. The disease ceases to progress on cessation of exposure.

Exposure to airborne concentrations of the dust should not exceed 5 fibers per cubic centimeter of air averaged over any 8-hour period and not to exceed 10 fibers/cc of air at any time. This limit refers to fibers greater than 5 microns in length. Fibers shorter than 5 microns do not present a health hazard.

Asbestos dust from chrysotile is less hazardous than from some other minerals. Crocidolite fibers for example are much more likely to produce cancer of the peritoneum (mesothelioma). Chrysotile predominates in asbestos used in the United States (95 percent of all asbestos used).

Fibers of asbestos imbedded in the skin can cause warts.

**Treatment of Overexposure:** There is no first aid or treatment for overexposure other than preventing further exposure by use of proper industrial hygiene controls. Any medical treatment is supportive and symptomatic only. Flush eyes with water and refer to ophthalmologist when dust gets into eyes.

**Personnel Protection:** Enclosure and local exhaust ventilation is the principal means of dust control. Approved dust respirators may be worn for some operations. Wear gloves and safety goggles.

## BENZALDEHYDE

Chemical Formula:  $C_6H_5CHO$

Synonyms: benzoic aldehyde; synthetic oil of bitter almond; almond artificial essential oil; artificial almond oil; oil of bitter almond; benzoic aldehyde; benzenecarbonol

Description: A colorless or yellowish liquid with the odor of bitter almond and a burning aromatic taste. Oxidizes in air to benzoic acid.

Fire Hazard: Combustible. Its vapors form flammable mixtures in air. Flash point is  $64^{\circ}C$  ( $148^{\circ}F$ ). Fire extinguishants are water spray, dry chemical, foam, or  $CO_2$ .

Toxicity: Moderately toxic by ingestion and by absorption through the intact skin. It acts as a central nervous system depressant and can cause respiratory failure.

Ingestion - The fatal oral dose is estimated to be about 2 ounces. Lower doses depress the nervous system and larger doses cause convulsions.

Skin contact - Benzaldehyde can act as a feeble local anesthetic; prolonged or frequent exposure results in dermatitis.

Treatment of Overexposure: Contact Medical Services.

Eyes - Flush promptly with plenty of water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

General - For ingestion, have victim drink water or milk if he is conscious. Induce vomiting.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. When adequate vapor control is not possible, e.g., spills, wear self-contained breathing apparatus.

Spill Control: Eliminate any sources of ignition and other flammables. For small spills absorb on paper towel and allow to evaporate to dryness in a fume hood. For large spills cover with sodium bisulfite. Add a small amount of water and mix. Scoop into a large beaker. After 1 hour wash down the drain with a large excess of water. Wash spill site with soap solution.

Storage: Keep containers closed; store in a cool, dark place.

Chemical Incompatibility: In general aldehydes can form unsafe combinations with acids, caustics, amines, ketones, phenols, cyanohydrins, ammonia, halogens, and acid anhydrides.

## BENZENE

Chemical Formula:  $C_6H_6$

Synonyms: benzol; coal naphtha; coal tar naphtha; cyclohexatriene; phene; phenyl hydride; pyrobenzol; benzole

Description: A clear, colorless, flammable liquid with an aromatic, solvent odor detectable at 4 to 5 ppm.

Fire Hazard: Benzene is flammable and highly volatile. It forms highly explosive mixtures with air within a range of 1.4 to 7 percent by volume. The flash point is  $-11^{\circ}C$  ( $12^{\circ}F$ ). Extinguish with dry chemical, foam or  $CO_2$ . Water may be ineffective.

Toxicity: Benzene is a high health hazard by inhalation and ingestion. It acts as a central nervous system narcotic and depresses the respiratory and circulatory processes. Prolonged exposure to lower concentrations causes bone marrow damage with blood disorders including anemia, and predisposes to leukemia, a blood cancer.

Inhalation - Exposure to airborne vapor should not exceed 1 part per million parts of air (ppm) averaged over an 8-hour period, nor 5 ppm peak concentration for any 15-minute period. The odor of benzene under ideal conditions can be detected as low as 5 ppm but is generally reported detectable at 100 ppm; 1000 ppm can be tolerated for a brief time; 20 000 ppm is immediately hazardous to life.

Skin and eye contact - Contact with the liquid can cause burning, edema and blistering. Systemic poisoning through skin absorption is possible, particularly through the injured skin. Moderate eye injury can occur due to splash contact accompanied by burning sensation. Remove contaminated clothes or shoes.

Ingestion - Swallowing benzene results in gastrointestinal irritation. A lethal oral dose can be as low as 15 mL.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush with water immediately

Skin - Wash with plenty of soap and water. Remove contaminated shoes and clothing immediately.

\*Ingestion - Administer gastric lavage followed by saline catharsis. Do not induce vomiting.

\*General - Artificial respiration and oxygen, if necessary. NO ADRENALIN; further treatment is supportive and symptomatic. Keep the victim warm and absolutely quiet.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. When adequate vapor control is not possible, e.g., in case of spills, wear self-contained breathing apparatus.

**Spill Control:** Eliminate all sources of ignition and flammables. Absorb spill on paper towels and evaporate to dryness in a fume hood.

**Storage:** Store in outdoor or detached well-ventilated area if possible or flammable liquid cabinet.

**Disposal:** May be burned in not more than 500 ml portions at an approved disposal area. A piece of alcohol-soaked cotton, burning on the end of a metal rod, is suitable as a fuse.

**Chemical Incompatibility:** Dangerous in contact with chlorine, chromic anhydride, perchlorates, liquid oxygen, and peroxides. Aromatic hydrocarbons in general can produce unsafe combinations with inorganic acids, halogens, and molten sulfur.



## BENZONITRILE

Chemical Formula:  $C_6H_5CN$

Synonyms: cyanobenzene; phenyl cyanide; benzoic acid nitrile

Description: Transparent, colorless oil with an almond-like odor

Fire Hazard: When heated to decomposition, it emits highly toxic cyanide fumes. Flammable; flash point 75° C.

Toxicity: Benzonitrile is a very toxic organic cyanide and resembles other cyanides in toxicity. Cyanides are fast-acting poisons, particularly if swallowed. Poisoning can result in loss of consciousness, convulsions, respiratory arrest, and death.

Inhalation - Exposure to airborne vapors of cyanides should not exceed a suggested limit of 5 milligrams per cubic meter of air, averaged over an 8-hour work period.

Ingestion - Swallowing this poison is the primary mode of exposure.

Skin - Cyanides cause eruptions and rash on prolonged contact. It can be absorbed through the intact skin.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush immediately with water

Skin - Wash with large quantities soap and water immediately.

Ingestion - If the victim is conscious, immediately induce vomiting. Secure medical treatment for cyanide poisoning.

General and inhalation - Administer artificial respiration and oxygen, if necessary. Secure medical treatment for cyanide poisoning.

Personnel Protection: Wear long rubber gloves, chemical goggles, and lab coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Absorb the liquid with vermiculite or paper towels. Evaporate to dryness and dispose of remains to waste in air-tight container. Wash spill site with soap solution containing some hypochlorite.

Disposal: Add excess of sodium hydroxide and calcium hypochlorite solution to produce a cyanate. Scoop slurry into a large beaker. After 1 hour flush down the drain with excess water.

Chemical Incompatibility: In general, nitriles can form unsafe combinations with acids, caustics, amines, and acid anhydrides.



## BORON TRICHLORIDE

Chemical Formula:  $\text{BCl}_3$

Synonyms: boron chloride; borane-trichloro

Description: A colorless, fuming liquid or colorless gas. The liquid fumes in moist air, producing hydrochloric acid

Fire Hazard: Dangerous when heated to decomposition. It produces toxic fumes of chlorides.

Toxicity: Inhalation of the vapors or gas depresses the central nervous system. Boron trichloride also depresses the circulation and in high concentrations can cause coma. Other effects are skin rash, vomiting, and shock. It is a corrosive agent and a respiratory irritant.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and is included here for information only, not for first aid action.

Eyes - Irrigate with plenty of water for at least 15 minutes.

Skin - Wash with plenty of water for at least 15 minutes. Immediately remove contaminated clothing and shoes.

\*General - Administer intravenous doses of isotonic salt solution and plasma. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., spills, wear self-contained breathing apparatus.

Spill Control: Eliminate sources of ignition. Cover spill with dry vermiculite, sodium bicarbonate, or a mix of soda ash and slaked lime (50-50). Mix. Spray water cautiously from an atomizer. Beware of a flash fire. Scoop up and add slowly to a large container of water. If too active, continue spraying. When reaction is complete, neutralize with 6M  $\text{NH}_4\text{OH}$  or  $\text{HCl}$  as required (litmus test) and wash down the drain with a large excess of water. Wash the spill site with soap solution.

Chemical Incompatibility: Dangerous in contact with nitrogen peroxide, phosphine, organic matter (such as grease), or oxygen.

## BROMINE

Chemical Formula:  $\text{Br}_2$

Description: Rhombic crystals which melt at  $-7^\circ \text{C}$  to a deep reddish-brown liquid. It has a bleach-like pungent odor detectable at less than 1 ppm.

Fire Hazard: Moderate fire hazard by spontaneous chemical reaction with reducing agents. May ignite combustible materials on contact. Emits highly toxic fumes when heated or contacted with water. Nonflammable.

Toxicity: Bromine is an extremely irritating liquid or vapor which can be injurious on inhalation, ingestion, or by contact.

Inhalation - Exposure should not exceed 0.1 part per million parts of air (ppm) averaged over an 8-hour work period. It is irritating to the eyes and upper respiratory tract at less than 1 ppm and 40-60 ppm can be dangerous on short exposure time. Severe exposures can cause pulmonary edema and death, e.g., 300 ppm for 3 hours, or 1000 ppm for brief exposure.

Skin and eye contact - Liquid contact with the skin causes burns and blisters and prolonged contact causes severe deep, painful ulcers; eye contact can cloud the cornea.

Ingestion - Swallowing as little as 1 milliliter can be fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes. Report to Medical Services.

Skin - Wash with plenty of water for at least 15 minutes.

(\*) Burns may be treated with sodium bicarbonate paste. Remove contaminated clothing immediately.

\*Ingestion - Gastric lavage followed by saline catharsis. Rinse mouth with 3 percent sodium carbonate solution or milk of magnesia.

\*Inhalation - Administer oxygen (and artificial respiration, if necessary).

\*Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, lab coat and rubber apron. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Cover with a reducer (hypo, not a bisulfite) such as a ferrous salt, but not carbon, sulfur or strong reducing agent. Mix well and spray with water. A sulfite or ferrous salt will require addition of some 3M sulfuric acid to promote rapid reduction. Scoop

slurry into a container of water, neutralize with soda ash, and wash down the drain with excess water. Wash the spill site thoroughly with a soap solution containing some reducer.

**Storage:** Store in a cool dry area out of direct sunlight. Separate from combustible, organic, or other readily oxidizable materials. Keep above  $-6^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ) to prevent freezing; however, heating above room temperature could rupture container.

**Chemical Incompatibility:** Bromine is particularly dangerous in contact with acetaldehyde, acetylene, antimony, acrylonitrile, aluminum dust or foil (warm), arsenic, ammonia, dimethyl formamide, ethylene, ethyl phosphine, hydrogen, methyl alcohol, methane, nickel carbonyl, potassium, sodium carbide, tin, and sulfur.

## N-BROMOSUCCINIMIDE

Chemical Formula:  $(\text{CH}_2\text{CO})_2\text{NBr}$

Synonyms: N-bromosuccinimide; succinbromide; succinibromimide; NBS

Description: White to pale buff colored fine crystals or powder with the faint odor of bromine.

Toxicity: It is highly toxic both by ingestion and inhalation. It is also a powerful irritant on contact with the skin, eyes, or mucous membrane. No detailed information on systemic effects or on treatment of victim of overexposure was found in reviewing the available literature.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. In case of spill wear self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition. Cover with vermiculite, sodium bicarbonate, or a sand-soda ash mixture (90-10). Mix. Scoop into cardboard container. Burn at approved disposal site.



## BUTYL ACETATE

Chemical Formula:  $\text{CH}_3\text{COOC}_4\text{H}_9$

Synonyms: n-butyl ethanoate; acetic acid, butyl ester

Description: A colorless liquid with a fruity odor. Butyl acetate has three common forms: normal, secondary, and tertiary.

Fire Hazard: It is a hazardous fire risk with a flash point of 72° F and explosive limits of 1.7 to 15 percent in air. Extinguish fires with dry chemicals, foam, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: It is a contact irritant and also depresses the central nervous system as a narcotic. Its odor is detectable at 10 parts of vapor per million parts of air (ppm); it is irritating to the eyes and respiratory tract at 200 ppm, and dangerous to life at 10 000 ppm. It can enter the body by inhalation and ingestion. Chronic poisoning has not been definitely established (long exposures to low concentrations).

Inhalation - Exposure to airborne vapors should not exceed 150 ppm for normal butyl acetate and 200 ppm for the other forms, averaged over an 8 hour work period. 10 000 ppm is dangerous after several hours of exposure.

Ingestion - The estimated fatal dose is 50 grams. It is a moderate irritant at low doses.

Skin and eye contact - Eye contact can result in conjunctivitis and small lesions of the cornea. Skin contact can produce scaly and fissured dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush eyes thoroughly with water; (\*) ophthalmic cortisone is recommended for conjunctivitis and keratitis.

Skin - Wash contaminated areas with soap and water. Remove contaminated clothing and shoes.

\*General - Administer oxygen therapy and artificial respiration as necessary. Further treatment is symptomatic and supportive.

\*Ingestion - Drink water or milk and induce vomiting, if conscious.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. When adequate vapor control is not possible, e.g., during spills, wear self-contained breathing apparatus or appropriate chemical cartridge respirator.

Spill Control: Eliminate all sources of ignition. Absorb spill on paper and evaporate to dryness in a fume hood.

**Storage:** Store in cool, well-ventilated area away from sources of ignition.

**Chemical Incompatibility:** Dangerous when contacted by potassium tertiary-butoxide.



## BUTYL ALCOHOL

Chemical Formula:  $C_4H_9OH$

Synonyms: butanol; hydroxybutane; methylolpropanol; butyl hydroxide; propylcarbinol; butyric alcohol; methyl ethyl carbinol; trimethyl carbinol

Description: A clear colorless liquid or crystal with a vinous or camphor-like pungent odor detectable at 25 parts of vapor per million parts of air.

Fire Hazard: Moderate fire hazard. Flammable from 1.5 to 11.3 percent by volume with a flash point of 11° to 38° C (52° to 100° F). Emits toxic fumes when heated to decomposition. Extinguish with dry chemical or  $CO_2$ . Water or foam may be ineffective.

Toxicity: Moderately toxic by skin contact, eye contact, ingestion, and inhalation of the vapors. It depresses the central nervous system and can damage the liver.

Inhalation - Exposure should not exceed 100 parts of vapor per million parts of air (ppm) averaged over an 8-hour work period.

Ingestion - The estimated lethal dose is about 30 grams.

Skin and eye contact - It is irritating to the skin and eyes and can produce severe eye damage.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with plenty of water for 15 minutes

Skin - Wash well with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Additional treatment is symptomatic and supportive. Administer artificial respiration and oxygen as needed.

Personnel Protection: Provide adequate ventilation and enclosure of processes to maintain airborne vapors below safe levels. If vapors exceed safe levels, e.g., during clean-up of a spill, wear the appropriate chemical cartridge respirator.

Spill Control: Eliminate sources of ignition and flammables. Absorb spill on paper towels and evaporate in a fume hood.

Disposal: Mix with more flammable solvent waste and burn at an approved disposal site.

Chemical Incompatibility: Hazardous when mixed with hydrogen peroxide.

## 2-BUTYNE-1,4-DIOL

Chemical Formula:  $C_4H_6O_2$

Synonyms: 1,4-butyne-1,3-diol

Description: Crystalline with a straw to amber color

Fire Hazard: When heated to decomposition it emits acrid fumes. In its pure state it is not explosive, but if it contains small amounts of certain impurities it may explode when exposed to heat.

Toxicity: Highly toxic by ingestion, inhalation, or by skin or eye contact. Acts as a systemic poison. Effects of long-term exposure to small amounts are not known.

Treatment of Overexposure: Contact Medical Services immediately.  
Eyes - Flush with plenty of water for at least 15 minutes  
Skin - Wash with soap and water.

Spill Control: Sweep into a combustible leak-tight container and burn at an approved disposal site.

Chemical Incompatibility: Small amounts of certain impurities, e.g., alkali hydroxides, alkaline earth hydroxides, or halides, may cause explosive decomposition upon distillation. It should not be treated with basic catalysts in the absence of a solvent even at room temperature. In strong acids contamination with mercury salts can also result in violent decomposition.

## BUTYRALDEHYDE

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CHO}$

Synonyms: butanal; butyric aldehyde; n-buty aldehyde; butaldehyde

Description: A colorless liquid with a pungent odor

Fire Hazard: Dangerous when exposed to heat or flame. Explosive limit is 2.5 to 17.5 percent. Flash point is  $-7^\circ\text{C}$  ( $20^\circ\text{F}$ ). Extinguish fires with dry chemical,  $\text{CO}_2$ , or foam. Water may be ineffective.

Toxicity: Butyraldehyde is a high eye contact hazard. It is moderately toxic by ingestion and as a contact irritant. It is slightly toxic by inhalation. High concentrations have caused pulmonary edema in animals, leading to death (from 8000 to 60 000 parts per million parts of air). Ingestion of six grams has produced death in rats. Its odor provides good warning properties.

Treatment of Overexposure: Contact Medical Services immediately.

Treatment is supportive and symptomatic.

Eyes - Immediately flush with plenty of water.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Ingestion - Drink water or milk if victim is conscious.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper towels and evaporate to dryness in a fume hood. In the case of a large spill, cover it with sodium bisulfite, add a small amount of water and mix. Scoop into a large beaker. After 1 hour flush down the drain with a large excess of water. Wash the spill site with soap solution.

Chemical Incompatibility: Dangerous in contact with chlorosulfuric acid, nitric acid, oleum, and sulfuric acid. In general, aldehydes can form unsafe combinations with acids, caustics, amines, alcohols, glycols, ketones, phenols, cyanohydrins, ammonia, halogens, and acid anhydrides.

## N-BUTYRONITRILE

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_2\text{CN}$

Synonyms: propyl cyanide; butanenitrile; butyric acid nitrile

Description: A colorless liquid

Fire Hazard: A high fire risk liquid with a flash point of  $26^\circ\text{C}$  ( $79^\circ\text{F}$ ). Extinguish fire with alcohol foam.

Toxicity: N-butyronitrile shows the high toxicity characteristics of the cyanides. It is highly toxic by inhalation or absorption through the intact skin and is rapidly poisonous. The dose that may be lethal when taken by mouth is relatively small compared to other acute poisons. The cyanides act as chemical asphyxiants, depriving the tissues of oxygen and producing convulsion, respiratory arrest and death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not as first aid actions.

Eyes - Flush with water

Skin - Immediately wash with soap and water.

\*Ingestion - Immediately induce vomiting if the victim is conscious; otherwise administer gastric lavage.

\*General - Whether the poisoning is by ingestion or inhalation the following applies: Administer artificial respiration, if necessary, and oxygen. Perform amyl nitrate inhalation therapy for 15 to 30 seconds of every minute until IV injection of 3 percent solution of sodium nitrite can be prepared and administered. Administer 10 ml over a 2-minute period and follow with 50 ml of 25 percent aqueous solution of sodium thiosulfate over a 10-minute period. Detailed medical treatment is available in the literature.

Personnel Protection: Wear long rubber gloves, chemical goggles, and lab coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., during a spill, wear a self-contained breathing apparatus.

Spill Control: Eliminate any sources of ignition and any flammables. Absorb liquid with paper towel or vermiculite. Evaporate to dryness in a fume hood. Wash the spill site with plenty of water.

Disposal: Add excessive sodium hydroxide and calcium hypochlorite solution. Transfer to a large beaker. After 1 hour drain into the industrial waste system with additional water.

Chemical Incompatibility: Nitriles are generally hazardous in contact with acids, caustics, amines, and acid anhydrides.



## CADMIUM CHLORIDE

Chemical Formula:  $\text{CdCl}_2$

Synonyms: cadmium dichloride

Description: Small white or colorless hexagonal crystals; no odor

Fire Hazard: When heated to decomposition, emits highly toxic chloride fumes. Not flammable.

Toxicity: The cadmium salts are extremely toxic both by inhalation of the vapors or dusts and also by ingestion. Cadmium chloride is an irritant and in addition to its role as a systemic poison it causes tissue damage by contact. Systemic poisoning effects include degenerative changes to the liver and kidneys. It is also considered to be a cause of cancer.

Inhalation - Exposure to airborne dusts or vapors should not exceed a suggested limit of 0.2 mg per cubic meter of air averaged over an 8-hour work period nor a peak concentration of 0.6 mg/M<sup>3</sup> at any time. Inhalation of a high concentration can occur without sufficient discomfort to warn the victim. High concentrations can cause lung edema, necrosis of lung tissue, pneumonitis, fibrosis, and emphysema with possibly fatal results.

Ingestion - The ingestion hazard is not as great since vomiting generally results. Swallowing as little as 10 milligrams has produced severe toxic symptoms and less than 1 gram can be fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items below marked (\*) are for the attention of medical personnel and are included for information only, not first aid action.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with soap and water.

\*Ingestion - Perform gastric lavage with water or milk followed by saline catharsis and demulcents, e.g., milk or beaten egg whites, at frequent intervals.

\*Inhalation - Administer positive pressure oxygen therapy. Treat edema by postural drainage.

\*General - Administer codeine sulfate for coughing and calcium disodium edelate intravenously. CaEDTA has been found to be effective. Do not administer BAL (dimercaprol). Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, safety glasses and lab coat.

If dust cannot be maintained below safe concentrations, e.g., in a spill situation, wear an approved mechanical filter respirator.

**Spill Control:** Collect spill in a beaker. Dissolve in a large amount of water. Add soda ash, mix and neutralize (litmus paper) with 6M HCl. Wash down the drain with excess water.

**Chemical Incompatibility:** Cadmium chloride mixed with potassium can produce a strong explosion on impact.



## CADMIUM PHOSPHATE

Chemical Formula:  $\text{Cd}_3(\text{PO}_4)_2$

Description: Amorphous, colorless crystals

Toxicity: Extremely toxic by inhalation of dusts or fumes or, on a lesser scale, by swallowing. Prolonged exposure by either route results in liver and kidney damage. High concentrations can cause coma and death.

Inhalation - A highly toxic concentration can be breathed without sufficient discomfort to warn the worker to leave the area. Toxic amounts may cause lung tissue damage, emphysema, edema, and death. Although no limit on airborne concentration of cadmium phosphate has been formally established, the recommended value is not to exceed 0.1 milligrams per cubic meter of air.

Ingestion - It is less toxic when ingested since hazardous amounts when swallowed usually cause vomiting, with symptoms similar to food poisoning. Sensory disturbances, convulsions, and coma can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes and skin contact - Flush with water

\*Ingestion - If vomiting does not occur immediately, administer gastric lavage with water or milk followed by saline catharsis and demulcents. Avoid BAL (dimercaprol).

\*Inhalation - Provide postural drainage for edema. Administer positive-pressure oxygen inhalation. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, safety glasses and lab coat. If dust cannot be controlled, e.g., in a spill situation, wear an approved mechanical filter respirator.

Spill Control: Collect spill in a beaker. Dissolve in a large amount of water. Add soda ash, mix and neutralize with 6M HCl. Wash down the drain with excess water.

## CALCIUM OXIDE

Chemical Formula:  $\text{CaO}$

Synonyms: lime; quicklime; burnt lime; calx; unslaked lime; fluxing lime; calcia

Description: A white or grayish-white lumpy solid which is odorless. Reacts vigorously with water.

Fire Hazard: It is not combustible but on contact with water may generate sufficient heat to ignite combustible materials (up to  $800^{\circ}\text{C}$ ). In fire situations avoid water unless necessary for adjacent burning materials, in which case flood with water to absorb the heat generated. Extinguish adjacent fires generally with dry chemicals or  $\text{CO}_2$ .

Toxicity: Calcium oxide is a strong irritant to the eyes, skin, and respiratory tract. It is caustic in action and can burn the tissue.

Inhalation - Exposure to airborne dust should not exceed 5 milligrams per cubic meter of air averaged over an 8-hour work period. It can cause pneumonitis and is reported to cause chemical pneumonia if the dust is inhaled.

Ingestion - If swallowed, it is strongly irritating to the mucous membrane. A lethal dose is estimated to be 36 grams.

Skin and Eye Contact - Eye contact can result in conjunctivitis, ulceration of the cornea, and permanent eye damage. Skin contact with presence of moisture can cause ulceration, skin burns, and dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush with water for 15 minutes and refer to Medical services. Additional irrigation with saline solution may be desired.

Skin - Wash with soap and water until free of soapy feeling. Remove contaminated clothing and shoes.

\*Treat for chemical burns.

\*Ingestion - Rapid and thorough gastric lavage is essential. Do not induce vomiting. Further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, lab coat, rubber apron and chemical goggles. Do not breathe dust. If adequate ventilation is not assured, e.g., in a spill situation, wear an approved mechanical filter respirator.

Spill Control: Sweep up, dilute, and neutralize with 6M-HCl in a large bucket. Wash down the drain with a large excess of water.

**Storage:** Store in a cool dry place separate from other chemicals.

**Disposal:** See Spill Control, above.

**Chemical Incompatibility:** Dangerous in contact with water, steam, acids, trifluorides, fluorine, and phosphorus pentoxide. Caustics in general form unsafe combinations with acids, halogenated compounds, aldehydes, ketones, esters, phenols, cyanohydrins, nitriles, halogens, phosphorus, and acid anhydrides.

## CAMPHOR

Chemical Formula:  $C_{10}H_{16}O$

Synonyms: bornane, 2-oxo-; 2-bornanone; 2-camphanone; formosa camphor; gum camphor; japan camphor; laurel camphor; natural camphor; 2-keto 1,7,7-trimethylbicyclo-(2,2,1)-2 heptanone; norcamphor, 1,7,7-trimethyl-; 1,7,7-trimethylbicyclo-(2,2,1)-2 heptanone; synthetic camphor

Description: White translucent or transparent crystalline mass with a penetrating, pungent odor and aromatic taste

Fire Hazard: A moderate fire and explosive hazard. The vapor is explosive from 0.6 to 3.5 percent by volume. The flash point is 66° C. Fight fires with water, foam, CO<sub>2</sub>, or dry chemical.

Toxicity: Camphor is very toxic by ingestion, inhalation of the vapors, and by contact. It acts as a systemic poison, first stimulating the central nervous system and causing convulsions and then depressing the CNS, causing collapse and respiratory failure. Degenerative changes in the kidneys and liver can result. It is considered to be the cause of some forms of cancer.

Inhalation - Exposure to the vapors should not exceed 2 parts per million parts of air averaged over an 8-hour work period.

Ingestion - Swallowing gram quantities is dangerous and less than 1 gram has been fatal to children.

Skin and eye contact - It is irritating to the skin and eyes and can be absorbed through the intact skin by contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water.

\*Ingestion - Gastric lavage with warm water followed by saline catharsis and diuretics. Control convulsions by IV sodium pentobarbital or short-acting barbiturates, chloral hydrate, or ether. Do not give opiates. Do not treat collapse with analeptics.

Personnel Protection: Wear rubber gloves, rubber apron, and chemical goggles or face shield. When adequate dust control is not possible, e.g., in spill situations, wear an approved chemical cartridge respirator.

Storage: Remove all sources of fire.

Spill Control: Eliminate all sources of ignition and flammables.

Sweep onto paper and place in cardboard container. Burn at an approved disposal site.



## CARBON DIOXIDE

Chemical Formula:  $\text{CO}_2$

Synonyms: carbonic acid gas; carbonic acid anhydride; carbonic anhydride; dry ice (in frozen form)

Description: A heavy colorless, odorless gas with a sharp taste. Non-combustible.

Toxicity:  $\text{CO}_2$  is not usually considered to be a toxic gas. It is a simple asphyxiant and will produce narcosis in high concentration. It is naturally present in the atmosphere in a concentration of about 300 ppm.

Inhalation - Exposure to the gas should not exceed 5000 parts per million parts of air (ppm) averaged over an 8-hour work period. At 20 000 ppm  $\text{CO}_2$  causes deeper breathing which becomes labored at 50 000 ppm. Concentrations high enough to exclude sufficient oxygen causes asphyxiation (100 000 ppm or 10 percent by volume).

Skin - Carbon dioxide in the solid, frozen form is dry ice. This should never touch any part of the body. Contact can cause freeze burns.

Treatment of Overexposure: Contact Medical Services immediately. Oxygen and artificial respiration as required.

Personnel Protection: Ventilate areas where air may have been displaced with  $\text{CO}_2$  before entering. Since  $\text{CO}_2$  is heavier than air, pockets may persist for some time unless positive ventilation is provided. For respiratory protection only the self-contained breathing apparatus or hose mask with blower is satisfactory.

Storage: Store in a well-ventilated, cool, dark area.

Chemical Incompatibility: Dangerous in contact with cesium monoxide, diethyl magnesium, lithium, potassium, potassium acetylene carbide, sodium, sodium carbide and titanium.

## CARBON DISULFIDE

Chemical Formula:  $\text{CS}_2$

Synonyms: Dithiocarbonic anhydride; carbon bisulfide

Description: A clear, colorless or faintly yellow heavy liquid with an ethereal odor. Odor can range from almost odorless to strong and disagreeable. The odor threshold is 1.2 parts per million parts of air (ppm).

Fire Hazard: Highly flammable. A dangerous fire and explosion hazard. Flash point is  $-30^\circ \text{C}$  ( $-22^\circ \text{F}$ ); auto-ignition temperature is  $100^\circ \text{C}$  ( $212^\circ \text{F}$ ); explosive range is 1 to 50 percent in air. Static electricity can spark and ignite the material. Fight fires with water,  $\text{CO}_2$ , or dry chemicals. However, water may be ineffective on the fire.

Toxicity: Carbon disulfide is a high health hazard by ingestion, inhalation, and absorption through the intact skin. It acts as a narcotic and anesthetic and can cause death by paralysis of the respiratory system. Central nervous system damage can result from prolonged exposure to lower doses.

Inhalation - Exposure to the vapors should not exceed 20 ppm averaged over an 8-hour work period, nor exceed 30 ppm at any time during the 8 hours except 100 ppm is permitted for up to 30 minutes. Concentrations of 320 to 390 ppm produce symptoms after a few hours of exposure and 1100 ppm can cause unconsciousness after 30 minutes; 4800 ppm is immediately hazardous to health.

Skin contact - It can cause dermatitis, blistering, and second degree burns depending on exposure conditions.

Ingestion - One-half ounce has proved fatal due to vascular collapse and respiratory failure.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water.

\*Ingestion - Administer gastric lavage with warm water followed by saline catharsis.

\*General - Keep victim warm and at rest. Administer artificial respiration and oxygen as necessary, and caffeine sodium benzoate (0.5 g) subcutaneously.

Personnel Protection: Wear rubber gloves, lab coat, rubber apron, and chemical goggles. If vapor control is not possible wear a self-contained breathing apparatus.



**Spill Control:** Have a CO<sub>2</sub> fire extinguisher on hand. Eliminate sources of ignition and flammables. Absorb on paper towels and evaporate to dryness in a fume hood.

**Storage:** Store in a detached, noncombustible area. Avoid direct sunlight. No electrical or heating facilities should be permitted. Protect against lightning and static electricity. Submerge storage vessels in water if practical or locate over a concrete basin containing water.

**Disposal:** See spill control above for small quantities. Larger amounts can be burned at an approved disposal site.

**Chemical Incompatibility:** Dangerous in contact with aluminum, acids, amines, ammonia, halogens, epichlorohydrin, azides, ethyleneimine, nitric oxide, nitrogen dioxide, zinc, and potassium.

## CARBON MONOXIDE

**Chemical Formula:** CO

**Description:** Colorless, odorless, tasteless gas: there is a slight garlic-like odor detectable at about 700 ppm; non-irritating

**Fire Hazard:** High, when exposed to heat or flame. CO readily forms explosive mixtures with air in a range of 12.5 to 74.2 percent by volume. Under fire conditions when the source is a flow of burning gas, use water to cool the fire until the gas is shut off. Then use CO<sub>2</sub>, water spray, or dry chemicals.

**Toxicity:** CO is not a tissue poison; its toxicity only occurs by inhalation. Chemical asphyxia reduces the oxygen carrying ability of the blood. Exposure should not exceed 50 parts per million parts of air (ppm) averaged over an 8-hour work period. Concentrations of 1000 ppm are dangerous and more than 3500 ppm is immediately hazardous to life. Poisoning severe enough to cause unconsciousness can result in damage to the central nervous system. In exposures greater than 50 000 ppm fatal cardiac arrest can occur.

**Treatment of Overexposure:** Contact Medical Services immediately. Immediately administer artificial respiration and give oxygen if necessary. A mixture of 5 percent carbon dioxide in oxygen is more likely to effect recovery from the poisoning than oxygen alone. Rest.

**Personnel Protection:** When adequate ventilation control is not possible, e.g., in source leaks, wear self-contained breathing apparatus.

**Storage:** Protect container from direct sunlight and store in a well-ventilated area.

**Leakage Control:** Maintain concentration of gas below the explosive mixture range by forced ventilation until the container can be moved outdoors to an open area. Allow to bleed off to the atmosphere.

**Chemical Incompatibility:** Dangerous when in contact with trifluorides, cesium monoxide, liquid oxygen, silver oxide, and lithium plus water.

## CARBON TETRACHLORIDE

Chemical Formula:  $\text{CCl}_4$

Synonyms: tetrachloromethane; benzinoform; perchloromethane; necatorine; carbon tet

Description: A clear, colorless heavy liquid with distinctive, sweet, ethereal odor detectable at 20 to 100 ppm depending on commercial source.

Fire Hazard: Nonflammable; but decomposes when heated and emits highly toxic gases including phosgene. Wear self-contained breathing apparatus.

Toxicity: A high health hazard. It is highly toxic when ingested as a liquid or inhaled as a vapor. Chronic exposure can cause severe injury to the liver and kidneys. It is believed to be a cause of cancer.

Inhalation - Exposure to vapors should not exceed 10 parts of vapor per million parts of air (ppm) averaged over an 8-hour work period and not to exceed 25 ppm at any time - except 200 ppm for 5 minutes in any 4 hours is acceptable. Inhaled, it acts as a narcotic, producing unconsciousness and respiratory failure in high concentrations. 2500 ppm can be fatal in 30 minute exposures and 50 000 ppm in 5-10 minutes.

Ingestion - Produces G.I. upset, liver and kidney damage, and neuritis.

Skin contact - Prolonged or repeated contact results in dermatitis. Absorption is not a serious hazard, but can prove to be toxic in sufficient amounts.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are not intended for first aid.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Gastric lavage with water or saline solution followed by saline catharsis. Instill saline cathartic. Respiratory stimulants if indicated.

\*Inhalation - Artificial respiration and oxygen, if required.

\*General - Do not administer alcohols, fats or oils, epinephrine, or ephedrine. Oxygen therapy, if indicated. Subsequent treatment is symptomatic and supportive. Renal damage may be indicated by nausea and vomiting within 24 hours of exposure.

Personnel Protection: Substitute less hazardous solvents when possible. Wear rubber or PVC gloves, lab coat and chemical goggles. Use in fume hood. When adequate vapor control is not possible, e.g., in spills, wear self-contained breathing apparatus.

**Spill Control:** Absorb on paper towels and allow to evaporate to dryness in a fume hood. Wash the spill site with soap solution.

**Storage:** Store in a cool, dry, well-ventilated area. Protect from direct sunlight.

**Disposal:** Dispose of by weathering in the open at an approved disposal site.

**Chemical Incompatibility:** Dangerous in contact with allyl alcohol, aluminum, barium, beryllium, calcium hypochlorite, dimethyl formamide, disilane, fluorine, lithium, liquid oxygen, potassium, sodium, zirconium. Halogenated compounds in general form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.



## CHLORINE

**Chemical Formula:**  $\text{Cl}_2$

**Description:** A greenish-yellow gas with a suffocating, irritating odor detectable at less than 1 ppm.

**Fire Hazard:** Nonflammable; moderate hazard since chlorine reacts with hydrocarbons, ammonia gas, and powdered metals, which causes fires, explosions, and poisonous gases. Container may explode in the heat of fire.

**Toxicity:** Chlorine is an extremely powerful irritating gas which causes severe tissue burns on contact.

Inhalation - Exposure should not exceed 1 part of gas per million parts of air (ppm) averaged over an 8-hour work period. The odor is detectable at 1 to 3 ppm. Prolonged exposure at 5 ppm causes lung irritation and bronchial damage; 14 to 21 ppm for 1 hour is dangerous; 500 ppm for 5 to 10 minutes can be lethal, and 1000 ppm is lethal after a few deep breaths. Injury deep within the lungs can occur.

Skin and eye contact - Severe burns and blistering may occur. Burns of the cornea of the eye can occur, and blindness result.

**Treatment of Overexposure:** Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid.

Eyes - Flush with plenty of water

Skin - Wash with plenty of water - remove contaminated clothing. Do not rub affected parts.

\*Inhalation - Administer oxygen (and artificial respiration, if necessary).

\*Inhalation of aerosol of aqueous sodium hyposulfite (2 percent) and sodium carbonate (0.5 percent) is helpful; inhalation of vapors of ethyl alcohol and ether is also useful.

General - Keep the victim as quiet as possible; keep warm; have the victim lie down with head elevated.

\*Epinephrine or ephedrine for bronchial spasm; codein for cough; sedation, if necessary.

**Personnel Protection:** Provide adequate ventilation to keep fume level within acceptable limits. Wear full protective clothing and chemical goggles. If adequate vapor control is not possible, e.g., during leaks or spills, wear self-contained breathing apparatus with full-face mask.

**Spill or Leak Control:** Use water spray to knock down vapor but do not spray leak itself. Bubble-leak gas through a reducer, e.g., sodium bisulfite, and excess sodium bicarbonate solution. Be sure

to include a trap in the line to prevent the solution being sucked back into the cylinder. If this cannot be done let the cylinder leak into a fume hood.

**Storage:** Protect against physical damage. Separate from combustibles, organics, or easily oxidizable materials. Store in a cool, dry well-ventilated area protected from weather and extreme temperature changes.

**Disposal:** Aqueous solutions can be disposed by careful addition of a caustic solution, e.g., NaOH. This can then be diluted with much water and discarded to an outside drain.

**Chemical Incompatibility:** Halogens can present unsafe conditions when mixed with caustics, alcohols, ethers, aldehydes, ketones, hydrocarbons, olefins, petroleum oils, esters, phenols; especially, ammonia, acetylene, hydrogen, sodium carbide, turpentine, acid anhydrides, hydrogen, or finely divided metals.



## CHLOROBENZENE

Chemical Formula:  $C_6H_5Cl$

Synonyms: chlorobenzol; MCB; monochlorobenzene; phenyl chloride; benzene chloride

Description: A clear colorless liquid with a sweet almond-like odor. Odor threshold is 60 parts per million parts of air (ppm).

Fire Hazard: A dangerous fire hazard; flash point  $29^{\circ}C$  ( $85^{\circ}F$ ) and autoignition temperature ( $638^{\circ}C$ ) ( $1180^{\circ}F$ ). Explosive range is from 1.8 to 9.6 percent in air. Poisonous gases are produced in fire. Extinguish with dry chemical, foam, or  $CO_2$ .

Toxicity: Chlorobenzene is moderately toxic by inhalation, ingestion, and by skin contact. It is not readily absorbed through the skin. It is a narcotic, chemical asphyxiant, and irritant.

Inhalation - Exposure to the vapors should not exceed 75 ppm averaged over an 8-hour work period. 200 ppm is irritating, 1200 ppm produces narcotic symptoms and 3700 ppm for 7 hours has caused death. Prolonged low level exposure can produce liver, lung, and kidney damage.

Skin and eye contact - Prolonged or frequent skin contact cause burns. Eye contact is mildly irritating.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with plenty water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Induce vomiting followed by gastric lavage and saline catharsis.

\*General - Administer artificial respiration and oxygen, if necessary. Keep victim warm; mild stimulant but no alcohol, fats, or oil. Treat for methemoglobinemia.

Personnel Protection: Wear rubber or neoprene gloves, lab coat, and chemical goggles. Use in fume hood. When adequate vapor control is not possible, e.g., spills, wear appropriate chemical cartridge respirator or self-contained breathing apparatus.

Storage: Keep containers tightly closed. Avoid heat.

Spill Control: Eliminate all sources of ignition. Absorb on paper towels or with vermiculite. Place in a fume hood and allow to evaporate. Wash the spill site with soap solution.

Disposal: Pour onto vermiculite, sodium bicarbonate, or a sand-soda ash mixture (90-10). Mix and place in cardboard containers. Burn at an approved disposal site.

## CHLOROFORM

Chemical Formula:  $\text{CHCl}_3$

Synonyms: trichloromethane; trichloroform; methenyltrichloride

Description: A heavy, very volatile, sweet-tasting, colorless liquid with ethereal odor.

Fire Hazard: Nonflammable; but when decomposed by heat, emits even more toxic gases such as chlorine and phosgene

Toxicity: A moderate health hazard. It is toxic by inhalation and by ingestion, and is a skin and eye irritant on contact. The primary effect of exposure is as an anesthetic and secondary effects are damage to the heart, liver, and kidneys. Addictions to chloroform have been reported. It is known to cause cancer to test animals under certain conditions.

Inhalation - Exposure to its vapors should at no time exceed 50 parts per million parts of air (ppm). Its odor is detectable at 50 to 200 ppm until olfactory fatigue sets in. It is narcotic at 14 000 ppm. High concentrations, e.g., 25 000 ppm for 5-10 minutes, result in unconsciousness, paralysis, and death by heart arrest or respiratory failure. Prolonged exposure at lower concentrations lead to toxemia, and internal organ damage.

Ingestion - Less toxic than carbon tetrachloride but a teaspoon can cause serious illness, and large amounts cause death. Animal studies have shown cancerous tumors on prolonged exposure.

Skin and eye contact - Chloroform is irritating to the eyes and skin, leading to conjunctivitis and dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid.

Eyes - Flush with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Gastric lavage followed by saline catharsis and emetics

\*Inhalation - Artificial respiration and oxygen, if necessary.

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear polyvinyl alcohol gloves or neoprene gloves, lab coat, and chemical goggles. Use in a fume hood. When adequate vapor control is not possible, e.g., spills, wear self-contained breathing apparatus with full-face mask.

Storage: Store: In dark place away from moisture.

**Spill Control:** Absorb on paper towels and evaporate to dryness in a fume hood. Wash the spill site with soap solution.

**Disposal:** Chloroform is insoluble in water and cannot be burned. It can be purified by redistillation.

**Chemical Incompatibility:** Dangerous in contact with acetone, aluminum, disilane, lithium, magnesium, nitrogen tetroxide, potassium, caustics, and sodium methylate. Halogenated compounds in general can form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## CHROMIC ACID

Chemical Formula:  $\text{CrO}_3$

Synonyms: chromium trioxide; chromic anhydride

Description: Dark, purple-red crystals.

Fire Hazard: Dangerous; a very powerful oxidizing agent. In contact with organic matter or reducing agents, it can cause violent reactions, including explosions. The container may explode when involved in fire. Will ignite on contact with acetic acid and alcohol. To fight fires use water; there is a possibility of a steam explosion.

Toxicity: Inhalation, ingestion, and direct contact can produce injury.

Inhalation - Inhalation of chromic acid mist as dilute as 5 percent or the oxide dust may cause inflammation of the mucous membrane and ulceration or perforation of the nasal septum. Mortality rates in the chromate industry strongly indicate that chromium oxide can produce lung cancer. Exposure to airborne mist or dust should not exceed a suggested limit of 0.1 mg per cubic meter of air.

Skin - Skin contact leads to dermatitis and small, painless ulcers. It may be absorbed through the skin in sufficient amounts to be a systemic poison. Eye contact causes conjunctivitis. The solid form or concentrated solutions can cause severe burns.

Ingestion - If swallowed, violent gastroenteritis and other poison actions occur including death. Injury to the liver can result.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water

Skin - Wash with soap and water.

\*Ingestion - Induce vomiting or administer gastric lavage. Give demulcents.

Personnel Protection: Wear rubber gloves, lab coat, and chemical goggles. Local exhaust ventilation is required. Emergency eye washing fountain should be available. When adequate dust control is not possible, e.g., spills, wear appropriate chemical cartridge respirator.

Spill Control: Cover spill with a reducer (hypo, a bisulfite, or a ferrous salt - but no carbon, sulfur, or strong reducing agent). Mix well and spray with water. A sulfite or a ferrous salt will require addition of some  $3\text{M-H}_2\text{SO}_4$  to promote rapid reduction. Scoop slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash site thoroughly



with a soap solution containing some reducer.

**Chemical Incompatibility:** Will ignite on contact with acetic acid or alcohols; separate from combustible organic or other readily oxidizable materials. Dangerous also in contact with acetone, aluminum, ammonia, benzene, camphor, diethyl ether, dimethyl formamide, glycerol, naphthalene, turpentine, pyridine, potassium, and sulfur.

## CHROMIUM ACETATE

Chemical Formula:  $\text{Cr}(\text{C}_2\text{H}_3\text{O}_2)_3 \cdot \text{H}_2\text{O}$

Synonyms: Chromic acetate

Description: A grayish-green powder or bluish-green pasty mass

Toxicity: Chromium compounds are irritating, corrosive, and may cause sensitizing reactions. They are toxic by inhalation, contact with skin and eyes, and by ingestion.

Ingestion - About 5 grams is estimated to be a fatal dose.

Inhalation - Exposure to the airborne dust should not exceed a suggested limit of 0.1 milligram per cubic meter of air averaged over an 8-hour work period. It can produce ulcerations in the respiratory system, perforation of the nasal septum, pneumonitis, and bronchial carcinoma.

Skin - It is corrosive and can produce ulcerations and sensitizing reactions.

Treatment of Overexposure: Contact Medical Services

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush eyes with water for at least 15 minutes.

Skin - Wash with soap and water.

\*Administer antihistamines and cortisone locally for dermatitis. Treat ulcerations with 10 percent edathamil calcium disodium in lanolin base.

Personnel Protection: Wear lab coat, rubber gloves, and chemical goggles. Maintain personal hygiene; no eating or smoking in the work area. If the powder could become airborne, e.g., during clean-up of a spill, wear an approved mechanical filter respirator.



## COBALT SULFATE

Chemical Formula:  $\text{CoSO}_4$

Synonyms: Cobaltous sulfate

Description: A red, water-soluble powder

Fire Hazard: Dangerous; when heated to decomposition it emits highly toxic fumes of sulfur oxide

Toxicity: Systemic poisoning can result by inhalation, skin contact, or ingestion. Cobalt sulfate is an irritant and a sensitizer. Its toxic effects include the stimulation of production of red blood cells (polycythemia), nerve deafness, and nephritis.

Inhalation - Produces bronchitis and asthmatic symptoms; acute lung irritant.

Ingestion - Its oral toxicity is low but of concern.

Skin and eye contact - Dermatitis and allergic reactions are common. Eye contact results in conjunctival irritation.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Gastric lavage followed by saline catharsis. Administer dimercapsol.

\*Inhalation - Symptomatic and supportive

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses.

Spill Control: Cover spilled solution with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with an excess of water. Collect spilled solid in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and dispose of as for the solution above.

## COPPER CHROMATE

Chemical Formula:  $\text{CuCrO}_4$

**Toxicity:** Copper compounds are moderate ingestion and inhalation hazards; the chromate salts are very toxic and corrosive. The chromates are associated with cancer of the lungs. Copper salts are often used as insecticides and fungicides.

Ingestion - In addition to its corrosive action, it acts as a systemic poison causing circulatory collapse and kidney, liver, and central nervous system damage.

Inhalation - The chemical can be absorbed through the lungs and become a systemic poison as well as causing lung irritation.

**Treatment of Overexposure:** Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Immediately flush with plenty of water for at least 15 minutes.

Skin - Wash with soap and water.

\*Treat local injuries like acid burns and scrub with 2 percent sodium hyposulfite.

\*Ingestion - Administer gastric lavage using milk or 0.1 percent potassium ferrocyanide. Administer egg white or other demulcents.

\*General - Administer morphine or Demerol for pain. Further treatment is supportive and symptomatic.

**Personnel Protection:** Wear rubber gloves, lab coat, and safety glasses.

**Spill Control:** Cover solution with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water. Collect spilled solid in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and neutralize and dispose of as above.

**Chemical Incompatibility:** Dangerous if mixed with acetylene, hydrazine, and nitromethane.

## COPPER DUST

Chemical Formula: Cu

Description: A reddish-colored metal.

Toxicity: Copper dust has relatively low toxicity by inhalation, ingestion, and contact with the skin.

Inhalation - Exposure to the airborne dust should not exceed 1 milligram of dust per cubic meter of air averaged over an 8-hour work period. Acute exposure can result in severe irritation of the nose and lungs accompanied by local swelling and injury to the lung cells.

Ingestion - Swallowing a toxic quantity (10 to 20 g) can damage the liver, kidney and spleen. It is also a strong irritant to the gastrointestinal tract. However, its emetic effects limit its toxicity. Injury to the gums and mucous membrane also occurs. Systemic poisoning has resulted in damage to the red blood cells and anemia.

Skin - Skin contact causes local dermatitis only rarely.

Treatment of Overexposure: Contact Medical Services. Generally, treatment is symptomatic and supportive. Where toxic amounts have been swallowed, gastric lavage with milk, egg white emulsion, or 1 percent potassium ferrocyanide has been useful, followed by saline catharsis.

Chemical Incompatibility: Dangerous when contacted by acetylene, ammonium nitrate, barium salts, bromates, chlorates, chlorine, fluorine, hydrazoic acid, hydrogen peroxide, hydrogen sulfide, iodates, magnesium salts, potassium peroxide, and hydrazine mononitrate.

## COPPER SULFATE

Chemical Formula:  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Synonyms: cupric sulfate; Roman vitriol; blue vitriol; blue stone; sulfate of copper; copper sulfate pentahydrate

Description: Blue crystals, granules, or powder with sweetish, metallic taste; odorless

Toxicity: Inhalation or ingestion can result in serious toxicity leading to coma and death. Exposure to skin and eyes results in irritation and other complications.

Inhalation - Results in congestion, ulceration, and systemic poisoning. Perforation of the nasal septum has occurred from chronic exposure.

Ingestion - Toxic amounts (less than 20 g) produce a host of symptoms leading to convulsions, shock, coma, and death. Prolonged exposure of small amounts result in liver, kidney, and spleen damage and anemia.

Skin and eye contact - Tissue damage, eczema, blisters and skin ulceration can occur; eye conjunctivitis and ulceration also occurs.

Allergic reactions have been observed.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid.

Eyes - Flush with water

Skin - Wash with water.

\*Ingestion - Gastric lavage using milk or 1 percent solution of potassium ferrocyanate. Administer egg white and other demulcents.

\*Inhalation - Treatment is symptomatic and supportive. Use proved medication which promotes copper excretion.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses.

Spill Control: Cover spilled solution with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with an excess of water. Collect spilled solid in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and dispose of as for the solution above.

Chemical Incompatibility: Dangerous if mixed with acetylene, hydrazine, and nitromethane.

## CUMENE

Chemical Formula:  $C_6H_5CH(CH_3)_2$

Synonyms: 1-methylethyl benzene; cumol; isopropylbenzene;  
2-phenylpropane; isopropylbenzol

Description: A clear, colorless liquid with a sharp gasoline-like penetrating odor.

Fire Hazard: It is flammable from 1 to 6.5 percent; flash point is  $36^{\circ}C$  ( $96^{\circ}F$ ). Fight fire with dry chemical, foam, or  $CO_2$ . Water spray may be ineffective.

Toxicity: Cumene is highly toxic by ingestion, inhalation, and skin absorption. It may irritate the eyes, skin, and upper respiratory tract. At sustained high levels of exposure narcosis leading to coma may occur. The sharp odor and irritating properties tend to limit exposures. Contact with the tongue produces painful burning sensations.

Inhalation - Exposure to airborne concentrations of the vapor should not exceed 50 parts vapor per million parts of air (ppm) averaged over an eight-hour work period. 2000 to 7000 ppm for 4 to 7 hours was lethal to mice. High concentrations are narcotic.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel, not for first aid action.

Eyes - Flush with running water for 15 minutes.

Skin - Wash with running water. Remove contaminated clothing and shoes.

\*Ingestion - Do not induce vomiting. Epinephrine is contraindicated.

\*General - Administer artificial respiration if necessary with oxygen therapy.

Personnel Protection: Wear rubber gloves, lab coat, and chemical goggles. When vapors cannot be maintained below safe levels by containment or ventilation, e.g., in case of spills, wear self-contained respirator.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill on paper towels and evaporate to dryness in a fume hood.

Chemical Incompatibility: Hazardous chemical reactions can occur between cumene and chlorosulfonic acid, nitric acid, and oleum. Aromatic hydrocarbons in general can produce unsafe combinations with inorganic acids, halogens, and molten sulfur.



## CUPRIC CHLORIDE

Chemical Formula:  $\text{CuCl}_2$

Synonyms: copper chloride; copper oxychloride

Description: A brownish-yellow powder or green crystals.

Toxicity: Cupric chloride is very toxic and when ingested is absorbed through the GI tract if retained. Apparent recovery may be followed in several days by a fatal relapse. It produces widespread blood vessel damage, kidney and liver injury, and central nervous system excitation followed by depression, convulsions and coma. Early death is due to shock; late death is due to liver or kidney failure.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes and skin contact - Wash with soap and water.

\*Ingestion - Administer gastric lavage using milk or 0.1 percent solution of potassium ferrocyanide; follow with egg white or other demulcent. Additional treatment may be found in the literature.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses.

Spill Control: Cover spilled solution with soda ash, mix and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water. Collect spilled solid in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and dispose of as for the solution above.



## CUPROUS CYANIDE

Chemical Formula: CuCN

Description: A white crystalline solid; usually powder.

Toxicity: A high toxic hazard whether swallowed, inhaled, or in contact with the skin. The cyanide is a chemical asphyxiant, depressing the central nervous system. Death may result from kidney damage, capillary injury, respiratory arrest, or heart failure.

Inhalation - Exposure to airborne dust should not exceed a suggested limit of 5 milligrams per cubic meter of air averaged over an 8-hour work period. It irritates the upper respiratory tract and mucous membrane.

Ingestion - If vomiting does not eliminate the poison, systemic poisoning occurs with a host of symptoms.

Skin and Eye Contact - It may be absorbed through the intact skin in sufficient quantity to act as a systemic poison. It is also an irritant to the skin and eyes.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel only, not for first aid actions.

Eyes - Flush with water

Skin - Wash with soap and water. Remove any contaminated clothing.

\*Ingestion - Administer gastric lavage with milk, followed by demulcents. Inject sodium nitrite, 10 mL of 3 percent concentration, over a 2 to 4 minute period intravenously followed by 50 mL of 25 percent sodium thiosulfate. Repeat hourly as necessary.

\*General - Administer morphine or Demerol for pain. Have victim inhale amyl nitrate for 15 to 30 seconds each minute. Administer artificial respiration, if necessary.

Personnel Protection: Wear long rubber gloves, lab coat, and safety glasses. Use in a fume hood. If dust or vapor control cannot be adequately maintained, e.g., during spills, wear self-contained respirator.

Storage: Store in cool, dry, well-ventilated area.

Spill Control: Scoop into a large beaker. Add a strong alkaline solution of calcium hypochlorite. Maintain an excess of sodium hydroxide and calcium hypochlorite. Let stand for 24 hours. Flush the cyanate down the drain with a large excess of water. Carry out the reaction in a fume hood to avoid exposure to any chlorine released.

Disposal: Add, with stirring, to strong alkaline solution of calcium hypochlorite. Maintain an excess sodium hydroxide and calcium

hypochlorite. Let stand 24 hours. Flush the cyanate down the drain with a large excess of water. Carry out the reaction in a fume hood due to the release of chlorine gas.

**Chemical Incompatibility:** When heated with magnesium it reacts with incandescence.

## CYANOACETIC ACID

Chemical Formula:  $\text{CNCH}_2\text{COOH}$

Synonyms: malonic mononitrile; cyanoethanoic acid

Description: white, deliquescent crystalline needles

Fire Hazard: Combustible. When heated to decomposition it emits toxic and flammable acetonitrile vapor. Water is effective in controlling fire, but the resultant liquid is extremely corrosive.  $\text{CO}_2$  and dry chemicals may also be used.

Toxicity: Cyanide compounds are among the fastest acting poisons known. They are toxic whether swallowed, inhaled, or absorbed through the intact skin. They inhibit tissue oxidation and are thus asphyxiant. Vapor can be absorbed through the skin.

Inhalation - The recommended airborne concentration limit is 5 milligrams per cubic meter of air, averaged over an 8-hour work period. No formal airborne concentration limit has been adopted for cyanoacetic acid.

Ingestion - Excessive dose results in a host of symptoms which can lead to central nervous system depression, difficulty in breathing, heart irregularities, loss of consciousness, convulsions, and death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel only, not for first aid.

Eyes - Flush with water

Skin - Wash immediately with plenty of water and soap. Remove any contaminated clothing.

\*Ingestion - Artificial respiration, if required.

\*Administer oxygen or an oxygen-carbon dioxide mixture. Inhale ampoule of amyl nitrate. Unless unconscious, immediately induce vomiting or administer gastric lavage. Additional follow-up and medication is found in the medical literature.

Personnel Protection: Wear long rubber gloves, lab coat and safety glasses. In case of fire wear self-contained respirator. No food or smoking should be permitted in the work area.

Storage: Store in a cool, well-ventilated area.

Spill Control: Eliminate all sources of ignition and flammables. Scoop solid into a large beaker and make alkaline with sodium hydroxide solution. Add to the slurry an excess of ferrous sulfate solution. After 1 hour flush down the drain with excess water. For spilled solutions absorb with paper towel and evaporate to dryness in a fume hood.

Disposal: Add, with stirring, to strong alkaline solution of calcium hypochlorite. Maintain an excess sodium hydroxide and calcium hypochlorite. Let stand 24 hours. Flush down the drain with a large excess of water. Carry out the reaction in a fume hood due to the release of chlorine gas.

Chemical Incompatibility: When mixed with furfuryl alcohol an explosion could occur.

## CYCLOHEXANE

Chemical Formula:  $C_6H_{12}$

Synonyms: hexahydrobenzene; hexamethylene; hexanaphthene; benzene hexahydride

Description: A colorless, flammable liquid, with a pungent gasoline-like odor.

Fire Hazard: Highly flammable. Use dry chemical, foam, or  $CO_2$ . Water may be ineffective. Flash point  $-20^{\circ}C$  ( $-4^{\circ}F$ ); flammable from 1.3 to 8 percent by volume.

Toxicity: Cyclohexane is a moderate hazard through inhalation of its vapors. It acts as a narcotic. It may contain benzene as an impurity.

Inhalation - Exposure to airborne vapor should not exceed 300 parts per million parts of air (ppm) averaged over an 8-hour work period. This concentration is detectable by odor and may be irritating to the mucous membrane. High concentrations may produce stupor, coma, respiratory paralysis, and death.

Skin and eye contact - The liquid is irritating to the skin and eyes. It is a defatting agent and may cause dermatitis.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of water.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Inhalation - If necessary, administer artificial respiration and oxygen. Further treatment is symptomatic and supportive.

Ingestion - Have victim drink water or milk, if conscious.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If vapors cannot be adequately controlled by ventilation, e.g., during a spill, wear the appropriate chemical cartridge respirator.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill on paper towels and allow to evaporate in a fume hood.

Storage: Prohibit open flame.

Disposal: Burn at an approved disposal site.

Chemical Incompatibility: Liquid nitrogen dioxide in contact with cyclohexane has caused an explosion. In general, aromatic hydrocarbons can form unsafe combinations with inorganic acids, halogens, and molten sulfur.



## 1,2-CYCLOHEXANE DICARBOXYLIC ANHYDRIDE

Chemical Formula:  $C_6H_{10}(CO)_2O$

Synonyms: hexahydrophthalic anhydride

Description: A clear, colorless viscous liquid which changes to a glassy solid at 35° to 36° C.

Toxicity: It is primarily toxic due to its strong irritant properties when inhaled or otherwise in contact with tissue. It is a strong irritant to the eyes and skin and in some instances is a dangerous skin sensitizer. This is true of the vapor, liquid, or solid form. No detailed information on systemic effects or on treatment of a victim of overexposure was found in reviewing the available literature.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: Eliminate all sources of ignition and flammable. Absorb the spill on paper towels and evaporate to dryness in a fume hood.

## CYCLOHEXANONE

**Chemical Formula:**  $\text{CO}(\text{CH}_2)_4\text{CH}_2$

**Synonyms:** Anone; hexanone; ketohexamethylene; Nadone; pimelic ketone; Sextone; Hytrol O; cyclohexyl ketone

**Description:** A clear to pale yellow oily liquid with an acetone or peppermint-like odor.

**Fire Hazard:** Moderate, when exposed to heat. Combustible. Flash point is 33° C. Explosive range from 1.1 to 8.1 percent. Use water spray, dry chemical, alcohol foam, or  $\text{CO}_2$  to extinguish fire.

**Toxicity:** It is moderately toxic, primarily through inhalation of the vapors, but also through skin contact and ingestion. It acts as an irritant, a mild narcotic, and in sufficiently toxic amounts may lead to death due to respiratory failure.

Inhalation - Exposure to vapors should not exceed 50 parts per million parts of air (ppm) averaged over the 8-hour work period. Even this concentration is irritating to the nose and throat. In animals 8000 ppm for 4 hours produced anesthesia and death. It has strong warning properties at fairly low concentration and so overexposure is unlikely by inhalation.

Ingestion - Cyclohexanone has low oral toxicity. The lethal amount by ingestion is not known.

Skin and eye contact - Absorption of toxic amounts through the skin by contact is unlikely except in excessive exposures. Prolonged or frequent contact can cause dermatitis. Eye contact produces marked irritation and injury to the cornea.

**Treatment of Overexposure:** Contact Medical Services immediately.

Eyes - Flush with running water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Subsequent treatment is symptomatic and supportive in nature.

**Personnel Protection:** Wear rubber gloves, chemical goggles or face shield, lab coat and rubber apron. Use within a fume hood. When vapors cannot be maintained below safe levels by containment or ventilation, e.g., in case of spills, wear approved chemical cartridge respirator.

**Storage:** Keep containers closed and in a cool, dark place.

**Spill Control:** Eliminate all sources of ignition and flammables. Absorb on paper towel and evaporate to dryness within a fume hood.

**Disposal:** Burn at an approved disposal site.

Chemical Incompatibility: It can react violently with nitric acid. Ketones in general can form unsafe combinations with inorganic acids, caustics, amines, ammonia, and halogens.

## DECAHYDRONAPHTHALENE

Chemical Formula:  $C_{10}H_{18}$

Synonym: decalin

Description: A colorless, water-white liquid with an aromatic odor

Fire Hazard: Decalin is combustible with a flash point of 58° C (136° F), autoignition temperature of 250° C (482° F), and explosive range from 0.7 to 4.9 percent in air.

Toxicity: It is moderately toxic by ingestion, inhalation of its vapors, and by contact. No serious industrial poisonings are known. Poisoning causes lung congestion, kidney and liver injury, and eye cataracts. Skin dermatitis and conjunctivitis result from skin and eye contact.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with running water

Skin - Wash with soap and water.

General - No additional treatment is suggested in the available literature.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper towels. Evaporate to dryness in a fume hood.

Disposal: Burn at an approved disposal site.

Chemical Incompatibility: Aromatic hydrocarbons in general form unsafe combinations with inorganic acids, halogens, and molten sulfur.

## DIBORANE

Chemical Formula:  $B_2H_6$

Synonyms: boroethane; boron hydride; diboron hexahydride

Description: A colorless, flammable gas with a repulsive, sweet odor, detectable at 3 ppm.

Fire Hazard: Diborane is very hazardous in that it is flammable and can ignite spontaneously between 38° and 52° C (125° F). It will detonate at concentrations between 2 and 25 percent and burn from 0.8 to 88 percent in air. The vapor is lighter than air. Extinguish fires with water.

Toxicity: Extremely toxic due to respiratory irritation. Inhalation, ingestion, and direct skin or eye contact can produce injury.

Inhalation - Diborane is highly irritating to the respiratory system and high concentrations produce edema and hemorrhage. Exposure to airborne vapors should not exceed 0.1 parts of gas per million parts of air (ppm) averaged over an 8-hour work period. The odor is detectable at 3 ppm and so odor is not a reliable warning of potentially toxic exposure. Greater than 300 ppm for a few minutes can result in serious consequences. No human fatalities have been reported.

Skin - Skin contact may lead to burns. Systemic poisoning by absorption through the intact skin is also possible. Systemic poisoning, whether by inhalation, ingestion, or absorption, can be injurious to the central nervous system, liver, and kidneys.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of professional medical personnel and are not first aid actions.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with soap and water or (\*) with 3 percent aqueous ammonia.

\*Inhalation - Administer oxygen with intermittent positive pressure technique.

\*Ingestion - Administer gastric lavage followed by saline catharsis. Additional treatment is symptomatic and supportive.

Personnel Protection: Flush equipment and apparatus with dry nitrogen before introducing diborane. Wear rubber gloves, chemical goggles, and lab coat. In case of leak immediately evacuate all personnel and use self-contained breathing apparatus for re-entry to stop leak. Use water spray to protect person effecting the shut-off.

Leak Control: Place cylinder in fume hood if leak cannot be stopped.

Disposal: Burn at an approved disposal site.



**Storage:** Store in cool, (<68° F) dry, well-ventilated place separate from halogens and other oxidizing agents. Check container periodically for decomposition. Protect against sparks and heat.

**Chemical Incompatibility:** Diborane is hazardous with ammonia, carbon tetrachloride, halides, halogenated hydrocarbons, nitric acid, oxygen, and nitrogen trifluoride. It ignites spontaneously in moist air. It forms hydrides with aluminum and lithium which may ignite spontaneously in air. It reacts violently with vaporizing liquid-type fire extinguishing agents, e.g., CCl<sub>4</sub>.

## 1,2 DIBROMOETHANE

Chemical Formula:  $\text{CH}_2\text{BrCH}_2\text{Br}$

Synonyms: ethylene dibromide; EDB; glycol dibromide; ethylene bromide

Description: A colorless, nonflammable liquid with a sweet odor. It slowly decomposes in the presence of light.

Toxicity: It is a very toxic substance and severe irritant. It is toxic by inhalation, ingestion, or by direct absorption through the skin. It acts as a central nervous system depressant. By any route, excessive uptake can cause death through respiratory or circulatory failure, liver and kidney damage, and pulmonary complications.

Inhalation - It is a moderate narcotic. The vapors can cause lung injury, lesions, and pneumonia.

Ingestion - Swallowing small quantities can produce severe symptoms and result in liver and kidney damage and depression of the central nervous system.

Skin and eye contact - Highly irritating, producing skin blisters and swelling. It will penetrate neoprene rubber and some plastic protective clothing.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are included here for information only, not for purposes of first aid.

Eyes - Flush with plenty of water for at least 15 minutes.

Skin - Wash with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes.

\*Ingestion - Gastric lavage followed by saline catharsis and demulcents.

\*Inhalation - Artificial respiration and oxygen, as necessary.

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. When vapors cannot be controlled by containment or ventilation, e.g., in case of spills, wear self-contained respirator.

Storage: Store in a cool, dry, well-ventilated area.

Spill Control: Eliminate all sources of ignition. Absorb spilled liquid with paper towels, or with vermiculite. Place in a fume hood and evaporate to dryness. Wash the spill site with soap solution.

Disposal: Dissolve in a flammable solvent and burn at an approved disposal site.

**Chemical Incompatibility:** It reacts vigorously with metals such as aluminum, magnesium, and sodium, with strong alkalis, and with oxidizing agents. It sinks in water forming toxic vapors.

## DIBUTYL PHTHALATE

Chemical Formula:  $C_6H_4(COO)_2(C_4H_9)_2$

Synonyms: dibutyl-1, 2-benzene dicarboxylate; phthalic acid, dibutyl ester; celluflex DPB; elaol; hexaphas; palatinol C; DBP; benzene-dicarboxylic acid, dibutyl ester

Description: A stable, colorless, oily, odorless liquid

Fire Hazard: Combustible with a flash point of 171° C (340° F).

Toxicity: Dibutyl phthalate is an inhalation and ingestion hazard and is a skin irritant. It has been used as an insect repellent and has low toxicity in animals. No permanent aftereffects have been reported.

Inhalation - Exposure to airborne vapors should not exceed 5 milligrams per cubic meter of air averaged over an 8-hour work period.

Ingestion - Ingestion of 10 grams has produced toxic symptoms including toxic nephritis.

Eye contact - Conjunctivitis and inflammation of the iris of the eye can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with running water

Skin - Wash with soap and water.

\*Ingestion - Administer gastric lavage followed by saline catharsis. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spilled liquid on paper towels and evaporate to dryness in a fume hood.

Disposal: Mix with a flammable solvent and burn at an approved disposal site. Or pour into sodium bicarbonate or a mixture of sand-soda ash.

Chemical Incompatibility: Esters in general create unsafe combinations with inorganic acids, caustics, amines, ammonia, and halogens.

## N,N-DIETHYL ACETAMIDE

Chemical Formula:  $\text{CH}_3\text{CON}(\text{CH}_3)_2$

Synonyms: dimethyl acetone amide; dimethylamide acetate; acetic acid, dimethylamide; DMA

Description: A colorless, combustible liquid. Flash point is 77° C (170° F). The vapor is explosive from 2 to 11.5 percent by volume in air.

Toxicity: It is moderately to highly toxic by inhalation, ingestion, and eye and skin contact. Prolonged exposure to small amounts may damage the liver, kidney, and heart. Exposure to larger quantities can cause central nervous system depression, hallucinations, coma, and death.

Inhalation - Exposure to the vapors should not exceed a suggested limit of 10 parts of vapor per million parts of air (ppm), averaged over an 8-hour work period. 100 to 200 ppm can produce injury.

Ingestion - Swallowing as little as 10 grams has proved to be fatal.

Skin and eye contact - It is a strong irritant. In addition, it can be very readily absorbed through the intact skin and produce cumulative systemic effects.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush eyes with plenty of water for at least 15 minutes

Skin - Flood immediately with water and then wash thoroughly with soap and water.

\*Ingestion - Induce vomiting and follow with gastric lavage and saline catharsis.

\*General - Subsequent treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses. Use in a fume hood. When vapors cannot be maintained at a safe level by containment or ventilation, e.g., in a spill, wear self-contained respirator.

Spill Control: Absorb spilled liquid with paper towels. Remove to an approved disposal site, add alcohol, and burn in a safe place.

Disposal: Add a flammable solvent, e.g., alcohol or benzene, and burn at an approved disposal site.



## DIETHYL CARBONATE

Chemical Formula:  $(C_2H_5)_2CO_3$

Synonyms: ethyl carbonate; carbonic acid, diethyl ether; diatol; eufin; carbonic ether; ethoxyformic anhydride

Description: A colorless liquid with a mild, pleasant odor

Fire Hazard: A moderate fire hazard with a flash point at 25° C (77° F). Flammable. Vapor may explode in a confined space. Extinguish with CO<sub>2</sub>, foam, or dry chemicals.

Toxicity: It is moderately toxic by ingestion and inhalation and is a strong irritant. No permanent effects from poisoning are observed. However, diethyl carbonate has produced neoplastic effects (the production of tumors) on overexposures.

Inhalation - The suggested limit of exposure to airborne vapors is 200 parts per million parts of air averaged over an 8-hour work period.

Ingestion - Harmful if swallowed.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water

Skin - Wash contaminated areas with soap and water. Remove contaminated clothing and shoes.

Ingestion - Have victim drink water or milk.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill on paper towels and evaporate to dryness in a fume hood.

Disposal: Mix with a flammable solvent and burn at an approved disposal site.

## DIETHYL SULFATE

Chemical Formula:  $(C_2H_5)_2SO_4$

Synonyms: sulfuric acid, ethyl ester; ethyl sulfate; DS

Description: A colorless, oily liquid with a faint ethereal or peppermint odor having an irritating after-effect.

Fire Hazard: Combustible; flash point is 104° C (220° F), autoignition, 436° C (817° F). It decomposes at higher temperatures, producing ethyl ether; oxides of sulfur may also form. To fight fires use alcohol foam, CO<sub>2</sub>, or dry chemical. Water or foam may cause frothing.

Toxicity: Diethyl sulfate is variously reported to be moderately to highly toxic by ingestion and inhalation, and is a strong irritant. It is also suspected of producing cancer in animal exposure tests.

Inhalation - No threshold limit value of permissible inhalation concentration has been proposed. 250 parts of vapor per million parts of air is the lowest published lethal concentration in animal experiments.

Skin and eye contact - Undiluted liquid in contact with the skin has destroyed skin tissue; severe eye injury has also resulted from animal exposures. No reports of human injury were found.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of water for 15 minutes.

Skin - Wash with soap and water. Medical services treat burns in usual fashion.

Ingestion - Medical Services should induce vomiting followed by stomach lavage and saline catharsis.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. When vapors cannot be maintained below safe levels by containment or ventilation, e.g., in spills, wear self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition. Absorb the liquid with paper towels and allow to evaporate to dryness in a fume hood. Wash the spill site with soap solution.

Disposal: Pour onto vermiculite, sodium bicarbonate, or a sand-soda ash mixture (90-10). Mix and shovel into a cardboard container. Burn at an approved disposal site.

Chemical Incompatibility: Hazardous chemical reactions can occur between diethyl sulfate and metals and water; sulfuric acid may form resulting in further formation of hydrogen.

## DIMETHYLFORMAMIDE

Chemical Formula:  $(\text{CH}_3)_2\text{NCHO}$

Synonyms: DMF; universal organic solvent; formyldimethylamine

Description: A colorless water-white liquid with an objectionable, ammonia-like (or fishy) odor detectable at 100 ppm.

Fire Hazard: A slight fire hazard; flash point is 57° C (135° F); flammable in a range of 2.2 to 15.2 percent by volume in air. Extinguish fire with alcohol foam, water,  $\text{CO}_2$ , or dry chemical. Emits carbon monoxide if heated to decomposition.

Toxicity: It is a moderate to high health hazard as a local irritant, by inhalation of its vapors, by ingestion, and by absorption through the intact skin. As a systemic poison it can produce moderate liver and kidney damage and act as a slight central nervous system depressant.

Inhalation - Exposure to airborne vapors should not exceed 10 parts of vapor per million parts of air (ppm) averaged over an 8-hour work period. 100 ppm can produce systemic poisoning; 200 ppm is highly irritating to the lungs. Lung irritation, edema, and desquamation can result from over-exposure.

Ingestion - Swallowing a small amount of the fluid can cause gastric irritation; 10 grams have proved to be fatal.

Skin and eye contact - The liquid is highly irritating to the skin, eyes, and mucous membrane. Defatting of the skin can result in dermatitis and peeling. Eye conjunctivitis can also occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with plenty of soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Induce vomiting, followed by gastric lavage.

\*General - Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If vapors cannot be maintained below safe levels by containment or ventilation, e.g., in spills, wear self-contained respirator.

Spill Control: Absorb spill on paper towels. Remove to an approved disposal site. Add alcohol and burn.

Storage: Store in cool, dark place. Tightly close the container.

Disposal: Place in combustible container, add combustible solvents, and burn in an approved open area.

Chemical Incompatibility: Forms unsafe combinations with bromine, carbon tetrachloride, chlorinated hydrocarbons, chromic anhydride, hexachlorobenzene, magnesium nitrate, methylene di-isocyanate, organic nitrates, phosphorus trioxide, and triethyl aluminum.

## DIMETHYL PHTHALATE

Chemical Formula:  $C_6H_4(COOCH_3)_2$

Synonyms: phthalic acid, dimethyl ester; avolin; 1,2-benzenedicarboxylic acid, dimethyl ester; fermine; dimethyl benzeneorthodicarboxylate; methyl phthalate; phthalic acid methyl ester; D.M.P.

Description: A colorless, odorless liquid.

Fire Hazard: A slight fire hazard when exposed to heat or flames.  
Flash point is 149° C (300° F). Extinguish fire with water, foam, CO<sub>2</sub>, or dry chemical. Water or foam may cause frothing.

Toxicity: A moderately toxic material by ingestion, inhalation of the vapors, or by direct contact with the skin or eyes. Action on the central nervous system can cause convulsions and coma. Skin irritant.

Inhalation - Exposure to the airborne vapors should not exceed 5 milligrams of vapor per cubic meter of air, averaged over an 8-hour work period.

Ingestion - Burning irritation of mouth can result. The estimated fatal dose is 50 grams.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.  
If vapors may exceed safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Absorb spill with paper towel and evaporate to dryness in a fume hood.

Disposal: Mix with a more flammable solvent and burn at an approved disposal site.



## DIMETHYL SULFIDE

Chemical Formula:  $(\text{CH}_3)_2\text{S}$

Synonyms: methyl sulfide; methylthiomethane; 2-thiapropane; DMS

Description: Colorless to straw-colored volatile liquid with a disagreeable odor.

Fire Hazard: Dangerous fire risk and a moderate explosion risk. Explosive range in air is 2.2 to 19.7 percent. Evolves toxic sulfur dioxide fumes when heated. Extinguish fires with dry chemical, foam, or  $\text{CO}_2$ . Water spray may be ineffective. Flash point  $-18^\circ \text{C}$  ( $0^\circ \text{F}$ ).

Toxicity: The open literature provided few details; dimethyl sulfide is deemed highly toxic. It can be detected by odor in air at well below 1 part vapor per million parts of air. Due to its high volatility, significant concentrations of vapor in air can be reached rapidly.

Inhalation - Produces inflammation and swelling; perforation of the nasal septum; bronchitis and pneumonia.

Ingestion - Burns the mucous membrane; produces cyanosis, convulsions, circulatory failure, and kidney and liver damage.

Personnel Protection: Wear rubber gloves, chemical goggles, and protective clothing. If vapors cannot be maintained below safe levels, e.g., in a spill, wear a chemical cartridge respirator or self-contained breathing apparatus.

Storage: Store in detached building if possible, away from flammables and oxidizing agents.

Spill Control: Eliminate all sources of ignition. Cover the spill with a weak aqueous solution of calcium hypochlorite (up to 15 percent) with stirring - 0.5 percent household bleach is also suitable. Scoop into a large beaker. After 12 hours neutralize (test with litmus) with 6M-HCl or 6M- $\text{NH}_4\text{OH}$  as necessary. Wash to sewer with excess water. Wash spill site with strong soap solution to which some hypochlorite has been added. Do not use dry hypochlorite - it could cause violent reaction or flash fire.

Chemical Incompatibility: Esters in general form unsafe combinations with inorganic acids, caustics, amines, ammonia, and halogens.

### 3,5-DINITROANILINE

Chemical Formula:  $(\text{NO}_2)_2\text{C}_6\text{H}_3\text{NH}_2$

Description: yellow crystals or powder with a musty odor.

Fire Hazard: Dangerous when heated to decomposition since highly toxic vapors are emitted. Flammable; may explode if subjected to heat or flame. Flash point  $224^\circ\text{C}$  ( $435^\circ\text{F}$ ). Extinguish fire with water,  $\text{CO}_2$ , or dry chemical. Emits poisonous gases when heated.

Toxicity: Highly toxic by ingestion, inhalation, and possibly by absorption through the intact skin. It is a powerful poison, causing injury to the kidney, liver, and spleen, bladder ulceration and tissue destruction, and hemolysis of blood cells severe enough to cause asphyxia and damage to the central nervous system.

Inhalation - Exposure to vapors should not exceed a suggested concentration of 1 part vapor per million parts of air, averaged over an 8-hour work period.

Ingestion - In addition to its systemic poison effects, dinitroaniline is highly irritating on contact with mucous membrane.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are not intended for first aid actions.

Eyes - Immediately flush with plenty of water.

Skin - Wash immediately with soap and water. Remove contaminated clothing and shoes and destroy.

\*Ingestion - Administer gastric lavage or emetics and cathartics. Administer oxygen therapy if necessary. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear butyl rubber gloves, chemical goggles, and lab coat. Use in a fume hood. If adequate control of vapors is not possible, e.g., during a spill, wear self-contained breathing apparatus.

Storage: Separate from easily combustible material or oxidizing agents.

Spill Control: Sweep onto paper. Burn at an approved disposal site. Wash the spill site thoroughly with strong soap solution.

Disposal: Pour onto sodium bicarbonate or a sand-soda ash mixture (90-10). Mix and package in cardboard containers. Pack with paper for fuel, and burn at an approved disposal site. Fire may be augmented with scrap wood.

## DINITROTOLUENE

Chemical Formula:  $C_6H_3CH_3(NO_2)_2$

Synonyms: dinitrotoluol; DNT

Description: Yellow needle crystals.

Fire Hazard: May explode when exposed to heat or flame. Evacuate surrounding area. Flash point 207° C (404° F).

Toxicity: Highly toxic by skin absorption, ingestion, and inhalation of its vapors. The effects may be delayed but result in liver injury, methemoglobinemia, and blood cell damage, resulting in anemia, cyanosis, and depression of the central nervous system.

Inhalation - Exposure to vapors should not exceed 1.5 milligrams per cubic meter of air, averaged over an 8-hour work period.

Ingestion - A fatal dose is estimated to be as low as 1 gram of the solid.

Skin contact - Dinitrotoluene is rapidly absorbed by the intact skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with plenty of water.

Skin - Immediately wash with plenty of soap and water. Remove contaminated clothing and wash or dispose by burning.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Administer oxygen therapy when necessary. Do not permit any intake of alcohol. Further treatment is supportive and symptomatic.

Personnel Protection: Wear butyl rubber gloves, chemical goggles, and lab coat. When dust control is not adequate, e.g., during spill, wear self-contained respirator or mechanical filter respirator.

Storage: Separate from strong oxidizers and reducing agents.

Spill Control: Sweep onto paper and package in a cardboard container. Pack with paper for fuel and burn at an approved disposal site. Wash the spill site thoroughly with strong soap solution.

Disposal: See spill control above.

## DIOXANE

Chemical Formula:  $\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{O}$

Synonyms: 1,4-diethylene dioxide; diethylene ether; di (ethylene oxide); glycol ethylene ether; dioxyethylene ether; 1,4-dioxacyclohexane

Description: A colorless flammable liquid with ether-like odor.

Fire Hazard: High fire and explosion hazard; flash point,  $12^\circ\text{C}$  ( $54^\circ\text{F}$ ); explosive range 2 to 22 percent in air. When distilled to dryness it can form an explosive mixture. Extinguish fires with alcohol foam, dry chemicals, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: A high health hazard by inhalation of the vapors, skin contact with the liquid, or by ingestion. It is known to cause cancer under certain conditions.

Inhalation - Exposure to airborne vapors should not exceed 100 parts per million parts of air (ppm) averaged over an 8-hour work period. Repeated exposures to relatively low concentrations have been fatal. The odor is not objectionable to most people below 500 ppm. It acts as a systemic poison causing injury to liver and kidney. Also, it depresses the central nervous system in high concentrations and can cause edema to the lungs. Thus odor has no warning value and must not be relied on.

Skin and eye contact - The liquid is irritating to the eyes and skin and dioxane can be absorbed through the intact skin in toxic amounts.

Ingestion - Animal studies have shown cancer of the liver and nasal passages when given in the drinking water at high doses.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush immediately with plenty of water for 15 minutes.

Skin - Wash with water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*Inhalation - Administer oxygen and artificial respiration, if necessary.

\*General - Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Use in a fume hood. When vapor levels cannot be maintained by containment and ventilation, e.g., during a spill, wear a self-contained breathing apparatus. High, short-duration concentrations should be avoided.

Storage: Isolate from combustible or oxidizing materials and all possible sources of ignition. Store outdoors or in a detached place, if possible.

Spill Control: Wear face shield. Eliminate all sources of ignition and flammables. Absorb on paper towels. Evaporate to dryness in a fume hood.

Chemical Incompatibility: Forms unsafe combination with hydrogen and Raney nickel and with silver perchlorate. Ethers in general are unsafe with inorganic acids, esters, and halogens.



## DIPHENYL

Chemical Formula:  $C_6H_5C_6H_5$

Synonyms: biphenyl; phenylbenzene; bibenzene; PHPH

Description: Several crystalline forms; white to light yellow scales or leaflets; pleasant odor; combustible. Odor detectable at less than 1 mg/cubic meter of air.

Fire Hazard: Flammable from 0.6 to 5.8 percent by volume. Flash point, 113° C (235° F). Extinguish fires with water, foam, CO<sub>2</sub>, or dry chemical. Water may cause frothing.

Toxicity: A high health hazard through exposure by contact, ingestion, or inhalation of the dusts or vapors. It can be absorbed through the intact skin. Systemic poisoning produces noticeable effects on the central nervous system; experimental exposures using animals has caused convulsions and paralysis.

Inhalation - Exposure to airborne dust or vapors should not exceed 0.2 parts per million parts of air averaged over an 8-hour work period. Moderate mucous membrane and eye irritation can result from high concentrations. The odor properties serve as a warning of undesirable concentrations.

Ingestion - Tissue irritation and gastrointestinal distress, as well as systemic poisoning, can result.

Skin and eye contact - Irritating to the skin and eyes.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water.

\*Ingestion - Administer gastric lavage or emesis followed by saline catharsis. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Where adequate containment and ventilation controls are not practical, e.g., in a spill, wear the appropriate mechanical filter respirator or a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Sweep onto paper and package for burning. Burn at an approved disposal site.

## ETHANE

Chemical Formula:  $C_2H_6$

Synonyms: ethyl hydride; methyl methane; dimethyl; bimethyl

Description: A colorless, gas with mild gasoline-like odor detectable at 900 ppm.

Fire Hazard: A dangerous fire hazard when exposed to heat or flame; explosive range 3 to 12.5 percent. Flash point  $-183^{\circ}C$ . Extinguish fire with water spray at source of leak, or with  $CO_2$  or dry chemical.

Toxicity: Ethane is a moderate inhalation hazard. It acts primarily as a simple asphyxiant which in high enough concentrations dilutes or excludes oxygen in the breathing air. In addition, some sources attribute to ethane narcotic effects and claim ethane is a central nervous system depressant. The suggested limit for exposure to ethane in air is 500 parts per million parts of air averaged over an 8-hour work period.

Treatment of Overexposure: Remove the victim from the ethane atmosphere. Contact Medical Services immediately. Administer oxygen and artificial respiration, if necessary. There are no permanent effects following recovery.

Leak Control: Maintain concentration in air below the explosive range by forced ventilation. Remove the container to an open area and permit it to bleed off to the atmosphere.

Chemical Incompatibility: Forms unsafe combinations with halogens, halogen oxides, and molten sulfur.

## ETHANOLAMINE

Chemical Formula:  $\text{HOCH}_2\text{CH}_2\text{NH}_2$

Synonyms: 2-aminoethanol; glycinol; 2-hydroxyethylamine; olamine; beta-aminoethyl alcohol; MEA; colamine

Description: A colorless, rather viscous liquid with ammonium-like odor. The odor is detectable at 2 to 3 parts per million (ppm).

Fire Hazard: Moderate hazard with a flash point of  $93^\circ\text{C}$  ( $200^\circ\text{F}$ ). Extinguish fire with foam,  $\text{CO}_2$ , or dry chemicals.

Toxicity: Moderately toxic by acute irritation, ingestion, and inhalation. Can cause liver and kidney damage on chronic exposure.

Inhalation - Exposure to the vapors should not exceed 3 ppm averaged over an 8-hour work period. Irritating to the respiratory system. Saturated vapors at normal working conditions are not immediately hazardous to life.

Ingestion - The estimated lethal dose is 10 grams.

Skin and eye contact - Causes severe irritation to the eyes and skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with water for at least 15 minutes and then get medical attention.

Skin - Wash with plenty of water. Get medical attention for skin burns.

\*General - Administer oxygen and artificial respiration if needed. Additional treatment is supportive and symptomatic.

Personnel Protection: Maintaining air concentrations below the odor level generally assures adequate control. If airborne concentrations exceed safe levels wear an approved respirator with an approved cartridge filter. Wear lab coat, rubber or butyl gloves, and chemical goggles.

Storage: Store in well-ventilated area, separated from flammable materials.

Spill Control: Wash away with water and dilute to nonflammable mixture.

## ETHYLENE

Chemical Formula:  $\text{CH}_2\text{CH}_2$

Synonyms: ethene; elayl; etherin; bicarburetted hydrogen; olefiant gas

Description: A colorless gas with a sweet odor and taste. •

Fire Hazard: A dangerous fire hazard when exposed to heat or flame.

Flash point  $136^\circ\text{C}$ . Range of explosive concentration in air is 3.1 to 32 percent. May be ignited by heat, sparks, or flames. Spray water on a fire whose source is a continuing leak of ethylene. When flow stops, use  $\text{CO}_2$ , dry chemical, or fine water spray.

Toxicity: Ethylene is a moderate hazard by inhalation. In high concentrations it acts as an asphyxiant and an anesthetic. Exposure should not exceed 1000 parts per million parts of air averaged over an 8-hour work day. Liquid form can cause frost-bite. Do not rub affected areas.

Treatment of Overexposure: There are no lasting effects. Remove the victim from the source of exposure. Contact Medical Services immediately. Administer oxygen and artificial respiration as necessary.

Personnel Protection: Wear self-contained respirator when concentration exceeds permissible limits.

Storage: Store in outdoor or detached area, if possible, or a well-ventilated, ignition-free location.

Leak Control: Eliminate all sources of ignition and flammables. Remove leaking container to a fume hood or to an open area and allow dissipation to the atmosphere.

Chemical Incompatibility: Ethylene is spontaneously explosive in sunlight with chlorine. It can react vigorously with oxidizing agents. Olefins in general form unsafe combinations with inorganic acids, halogenated compounds, halogens, and molten sulfur.

## ETHYLENE DICHLORIDE

Chemical Formula:  $\text{CH}_2\text{ClCH}_2\text{Cl}$

Synonyms: brocide; ethane dichloride; dichloroethylene; Dutch oil; glycol dichloride; 1,2-dichloroethane; EDC; ethylene chloride

Description: A colorless oily liquid with a chloroform-like odor; sweet taste.

Fire Hazard: Dangerous. When heated to decomposition it emits highly toxic fumes of phosgene. Explosive range from 6.2 to 15.9 percent. Flash point  $13^\circ\text{C}$  ( $56^\circ\text{F}$ ). Vapor is heavier than air. Extinguish fires with dry chemicals, foam, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: A high irritation, ingestion, and inhalation hazard. It is a strong narcotic and systemic poison, injurious to liver and kidney, and can produce pulmonary edema.

Inhalation - Exposure to its vapor should not exceed 50 parts per million parts of air (ppm) averaged over an 8-hour work period, and not exceed 100 ppm at any time (except 200 ppm is permitted for not more than 5 minutes in any 3 hr). The distinctive odor and irritating effects give warning of its presence in relatively safe concentrations.

Skin - Skin contact causes fissured dermatitis and burns. In eyes, contact can produce corneal ulceration.

Ingestion - As little as 20 to 50 milliliters has caused death. It is several times more toxic than carbon tetrachloride when swallowed.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Wash with soap and water.

\*Ingestion - Induce vomiting followed by gastric lavage and saline catharsis. Demulcents may follow.

\*General - Artificial respiration and oxygen administration, if necessary. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear polyvinyl alcohol gloves, chemical goggles, and lab coat. Use in a fume hood. If vapors cannot be maintained below safe limits, e.g., in a spill, wear a self-contained breathing apparatus. Keep containers closed when not in use.

Storage: Outdoor or detached storage, if possible; otherwise, a well-ventilated, cool location.

Spill Control: Eliminate all sources of ignition. Absorb on paper towels or with vermiculite. Allow to evaporate to dryness in a fume hood. Wash the spill site with soap solution.



**Disposal:** Pour onto vermiculite, sodium bicarbonate, or a sand-soda ash mixture (90-10). Mix and shovel into leak-tight cardboard containers. Incinerate at an approved disposal site, using scrap wood to accelerate the burn.

**Chemical Incompatibility:** It is hazardous when contacted with ammonia, or dimethyl amino propyl amine. Halogenated compounds in general can produce unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## ETHYLENE GLYCOL

Chemical Formula:  $\text{CH}_2\text{OHCH}_2\text{OH}$

Synonyms: ethylene alcohol; Glycol; glycol alcohol; 1,2-ethane-diol; 1,2-dihydroxyethane; ethylene dihydrate; Lutrol-9; monoethylene glycol.

Description: A clear, colorless, syrupy liquid with a sweet taste; odorless.

Fire Hazard: Slight fire hazard when exposed to heat or flame. Flash point is  $111^\circ\text{C}$  ( $232^\circ\text{F}$ ). Flammable above 3.2 percent. Extinguish fires with water, alcohol foam,  $\text{CO}_2$ , or dry chemical.

Toxicity: Ethylene glycol is primarily toxic by ingestion. It stimulates and then depresses the central nervous system and can severely damage the kidneys, causing death.

Inhalation - Due to its low vapor pressure it is not generally an inhalation hazard unless heated or dispersed as a mist. Exposures should not exceed 100 parts per million parts of air, averaged over an 8-hour work period.

Skin contact - It is not readily absorbed through the skin but can cause minor skin irritation.

Ingestion - Ingestion can result in inebriation, coma, seizures, respiratory failure, renal failure and cardiovascular collapse. 100 ml has proved to be fatal in man.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid section.

Eyes and Skin contact - Flush eyes with water; wash skin with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage followed by saline catharsis; calcium gluconate by IV if necessary. Analeptic drugs should be avoided; supportive drugs for renal failure. Administer oxygen and artificial respiration if necessary. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, lab coat, and chemical goggles. No eating should be permitted in the work area. If vapors could exceed safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus or an approved all-purpose canister respirator.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill with paper towels. Evaporate to dryness in a fume hood.

Storage: Store large quantities preferably in resin-coated stainless steel or aluminum containers. Close containers tightly to avoid moisture. Store separate from oxidizing materials.

Chemical Incompatibility: Dangerous when reacted with perchloric acid, chlorosulfonic acid, oleum, or sulfuric acid. Glycols in general can form unsafe combinations with inorganic acids, aldehydes, esters, alkylene oxides, halogens, or acid anhydrides.

## ETHYLENE GLYCOL MONOETHYL ETHER

Chemical Formula:  $\text{HOCH}_2\text{CH}_2\text{OC}_2\text{H}_5$

Synonyms: glycol monoethyl ether; Cellosolve; 2-ethoxyethanol; Oxytol

Description: A colorless oily liquid; odorless or with a mild ethereal odor and bitter taste.

Fire Hazard: Moderate; range of explosive concentration in air 1.8 to 14.0 percent. Flash point,  $94^\circ\text{C}$  ( $202^\circ\text{F}$ ). Extinguish fires with dry chemicals, alcohol foam, or  $\text{CO}_2$ .

Toxicity: Moderately toxic by ingestion, inhalation of the vapors, or by absorption through the intact skin. It is a central nervous system depressant and acute exposure can injure the kidney or liver.

Inhalation - The suggested limit to exposure to airborne concentrations of the vapors is 200 parts per million parts of air averaged over an 8-hour work period. Higher concentrations for prolonged periods can damage the lungs, in addition to the effects described above.

Ingestion - Although considered to have low oral toxicity, if sufficient amounts are swallowed, coma followed by death due to respiratory failure or kidney damage can result.

Skin and eye contact - It is not irritating to the skin but is fairly irritating to the eyes and mucous membrane.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

\*Eyes - Flush with water or with 0.9 percent saline solution.

Skin - Wash with soap and water. Remove contaminated clothing or shoes.

\*Ingestion - Administer gastric lavage with 1:5000 potassium permanganate solution.

\*General - Subsequent treatment is symptomatic and supportive. Administer oxygen and artificial respiration, if necessary.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. If vapor concentration cannot be maintained below safe levels, e.g., during a spill, wear the appropriate chemical cartridge respirator.

Storage: Keep containers closed and protect from moisture.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper. Evaporate to dryness in a fume hood.

Chemical Incompatibility: When exposed to air it can form peroxides that are highly explosive. Ethers in general can form unsafe combinations with inorganic acids, esters, and halogens.

## ETHYL ETHER

Chemical Formula:  $C_2H_5OC_2H_5$

Synonyms: anaesthetic ether; diethyl ether; diethyl oxide; ethyl oxide; ether; ethane, 1,1-oxybis; ethoxyethane; solvent ether; sulfuric ether

Description: A clear, colorless, highly volatile, extremely flammable liquid with an aromatic odor and sweet taste.

Fire Hazard: The explosive limits are 1.9 to 36 percent by volume; the flash point is  $-45^{\circ}C$ ; ignition temperature  $180^{\circ}C$  ( $356^{\circ}F$ ). Readily ignited by static electricity. Fight fires with dry chemical, foam, or  $CO_2$ . Water spray may be ineffective.

Toxicity: Ethyl ether is not a toxic poison but is an irritant and a narcotic.

Inhalation - Exposure to airborne vapors should not exceed 400 parts per million parts of air (ppm) averaged over an 8-hour work period. Three hundred ppm is usually objectionable. As a surgical anaesthetic ethyl ether is used in 5 percent to 10 percent but respiratory arrest may occur above 7 percent.

Skin and eye contact - It is a mild skin irritant due to its defatting action. It is irritating if splashed in the eyes.

Ingestion - One to 2 ounces may be fatal if swallowed. It is irritating to the mucous membrane and produces rapid symptoms associated with chronic alcoholism.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with soap and water. Remove contaminated shoes and clothing.

Ingestion - If victim is conscious have him drink water or milk.

Inhalation - Artificial respiration and oxygen, if necessary.

General - Treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield and lab coat. Handle within a fume hood. When containment and ventilation are not adequate to maintain the vapor concentration below safe limits, wear self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition. Absorb spill with paper towels. Allow to evaporate to dryness within a fume hood.

Disposal: Pour on ground in open area at an approved disposal site. Allow to evaporate.

Storage: Detached outdoor storage preferred. Isolate from other combustible materials. Avoid direct sunlight.



Chemical Incompatibility: Reacts with the oxygen in the air to form unstable peroxides. An inhibitor of 1 percent ethyl alcohol can delay formation of peroxides for more than a year. Gross peroxide formation may be evidenced by presence of crystalline solids in the bottom of the container. These are shock sensitive. Do not use this material. Easily ignites by contact with nitric acid or fuming sulfuric acid. Ethers in general can form unsafe combinations with inorganic acids, esters, and halogens.

## ETHYL SILICATE

Chemical Formula:  $(C_2H_5)_4SiO_4$

Synonyms: tetraethyl orthosilicate; tetraethoxysilane; tetraethyl silicate; TEOS; silicic acid, tetraethyl ester

Description: A colorless, volatile liquid with a faint to sharp odor detectable at 85 ppm.

Fire Hazard: Flammable, with a flash point of 52° C (125° F). May be extinguished using a water spray, CO<sub>2</sub>, or dry chemical.

Toxicity: Ethyl silicate's primary hazardous characteristic is its irritating effect on eyes, nose, and respiratory passage. High concentrations of the vapor are narcotic and can be lethal.

Inhalation - Exposure should not exceed 100 parts per million parts of air (ppm) averaged over an 8-hour work period. The odor is detectable at 85 ppm, so concentrations of vapor that can be smelled should be considered as unsafe. Two hundred fifty ppm is irritating and 3000 ppm is intolerable; animal experiments at 400 ppm resulted in death after 30 days exposure. Long-term exposure to high concentrations has resulted in injury to lungs, liver, and kidney.

Skin and eye contact - The liquid and vapor are irritating to the eyes and other mucous membrane. Contact of the liquid with skin surfaces should be avoided. It hydrolyzes to silicic acid on contact with moisture of the skin.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with running water for at least 15 minutes.

Skin - Wash with soap and water.

Inhalation - Treatment by medical personnel should be supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. When vapors cannot be kept below safe levels by containment or ventilation, e.g., during a spill, wear a respirator designed for protection against organic vapors plus fume particulate. If concentrations of vapors can exceed 700 ppm wear a self-contained breathing apparatus.

Storage: Store in cool, well-ventilated area free from sources of ignition.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill with paper towels. Evaporate to dryness in a fume hood.

Disposal: Mix with a more flammable solvent and burn at an approved disposal site.

Chemical Incompatibility: Ethyl silicate decomposes in the presence of water.

## FERROUS AND FERRIC CHLORIDE

Chemical Formulae:  $\text{FeCl}_2$ ;  $\text{FeCl}_3$

Synonyms:  $\text{FeCl}_2$  = Lawrencite; iron dichloride  
 $\text{FeCl}_3$  = flores martis; iron trichloride

Description:  $\text{FeCl}_2$  = white or green to yellow crystals  
 $\text{FeCl}_3$  = a black-brown deliquescent solid

Fire Hazard: When heated to decomposition they both form highly toxic fumes of hydrogen chloride.

Toxicity: Both moderately toxic by ingestion or by inhalation; corrosive and irritant on contact with the skin.

Inhalation - Inhalation of the dust results in irritation and some degree of pulmonary edema, hemorrhage, and pneumonitis.

Ingestion - Corrosive to the gastric mucosa. Also acts as a systemic poison producing liver damage and kidney degeneration. Large overdoses (5-10 g) can result in shock, coma, respiratory and circulatory collapse, and death.

Skin and eye contact - Skin irritation and conjunctivitis result.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water.

\*Ingestion - Administer gastric lavage with 1 pint of 5 percent aqueous solution of monosodium phosphate followed by milk, emetics, and saline catharsis. Demulcents may follow.

\*Inhalation - Oxygen therapy as indicated.

\*General - Supportive and symptomatic treatment.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Ferric chloride is particularly corrosive and should be handled in a fume hood. If dust could become airborne, e.g., during clean-up of a spill, wear appropriate respirator.

Storage: Keep containers tightly closed.

Spill Control: (a) Ferric chloride - cover spill with excess sodium bicarbonate. Scoop the mixture into a large beaker of water and let stand for a few minutes. Slowly pour into a drain with large amounts of water. Wash spill site with soapy water. (b) Ferrous chloride - Cover spill with soda ash, mix and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water.

Chemical Incompatibility: Ferric chloride can form unsafe combinations with allyl chloride, potassium, and sodium; ferrous chloride can form unsafe combinations with ethylene oxide, potassium, or sodium.

## N-HEPTANE

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$

Synonyms: dipropyl methane; heptane; heptyl hydride

Description: A colorless transparent liquid which is a principle component of gasoline; aromatic odor.

Fire Hazard: A dangerous fire hazard when exposed to heat or flame. Explosive range is 1.2 to 6.7 percent in air, flash point is  $-4^\circ\text{C}$  ( $25^\circ\text{F}$ ). Extinguish fire with dry chemical, foam, or  $\text{CO}_2$ . Water spray may be ineffective on the fire.

Toxicity: n-Heptane is a moderate hazard when the vapors are inhaled in high enough concentrations. Exposure to airborne vapors should not exceed 500 parts per million parts of air (ppm) averaged over an 8-hour work period. It acts as a narcotic and irritant. 5000 ppm for 4 minutes has caused dizziness, incoordination, and hilarity. High enough concentrations can produce convulsions and stupor.

Treatment of Overexposure: There are no lasting effects as n-heptane does not act as a systemic poison. Remove the victim from the source of exposure. Contact Medical Services immediately. Administer oxygen and artificial respiration, if necessary. Remove contaminated clothing and shoes. Do not induce vomiting, if victim swallowed the liquid. He may drink water or milk. Flush eyes with water and wash skin with soap and water.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. If vapors cannot be maintained below safe levels by ventilation and enclosure of processes, e.g., during clean-up of spill, wear a self-contained breathing apparatus.

Storage: Keep container tightly closed and avoid sources of ignition.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper towels and evaporate to dryness in a fume hood.

Disposal: May be mixed with a more flammable solvent and burned at an approved disposal site.

Chemical Incompatibility: Heptane is hazardous in contact with phosphorus plus chlorine. Saturated hydrocarbons in general form unsafe combinations with halogens and molten sulfur.



## HEXAMETHYLPHOSPHORIC TRIAMIDE

Chemical Formula:  $[N(CH_3)_2]_3-PO$

Synonyms: hempa; HMPA; hexametapol; HMPT; HPT; phosphoric tris (dimethyamide); phosphoryl hexamethyltriamide; hexamethylphosphamide; tris (dimethylamino) phosphorous oxide

Description: A colorless liquid widely used as a solvent in laboratories. It has a mild amine odor and is combustible.

Toxicity: There is no information on the toxic effects on humans. It has a variety of toxic effects on test animals including kidney disease, lung damage, and nervous system dysfunction. Malignant nasal tumors have been produced by inhalation of HMPA vapors daily at concentrations of 0.4 to 4.0 parts per million parts of air, after 8 months of exposure.

Personnel Protection: Wear butyl rubber gloves, safety glasses, and lab coat.

Spill Control: Absorb with paper towels and evaporate to dryness in a fume hood. Wash the spill site thoroughly with strong soap solution.

## HEXANE

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$

Synonym: hexyl hydride

Description: A clear, colorless volatile liquid with a faint gasoline-like odor

Fire Hazard: A dangerous fire hazard; highly flammable with a flash point of  $-9^\circ\text{F}$  ( $-23^\circ\text{C}$ ), autoignition temperature is  $500^\circ\text{F}$  ( $260^\circ\text{C}$ ). Explosive limits are 1.3 to 6.9 percent by volume. Extinguish fires with dry chemical, foam, or  $\text{CO}_2$ . Water may be ineffective on the fire.

Toxicity: Hexane in its pure state is moderately toxic but it is very likely to be contaminated with the more highly toxic benzene. It acts as a narcotic and anaesthetic and is not a systemic poison. Recovery is usually complete with no after-effects.

Inhalation - Exposure to the vapors should not exceed 500 parts per million parts of air (ppm) averaged over an 8-hour work period. 1300 ppm is irritating, and 30 000 ppm has been narcotic in animal tests, with death at 40 000 ppm.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*General - Administer artificial respiration and oxygen if necessary. Further treatment is symptomatic and supportive. However, impurities in the hexane such as benzene should be considered in evaluating the health hazard.

Ingestion - If victim is conscious, have him drink water or milk; do not induce vomiting.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. If concentration of vapors cannot be kept below safe levels by containment and ventilation, e.g., during a spill, wear a self-contained respirator.

Storage: Store in a well-ventilated, cool, dark place.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill with paper towels. Evaporate to dryness in a fume hood.

Disposal: Mix with a flammable solvent and burn at an approved disposal site.

Chemical Incompatibility: Saturated hydrocarbons in general form unsafe combinations with halogens and with molten sulfur.

## HYDRAZINE

Chemical Formula:  $\text{NH}_2\text{NH}_2$

Synonyms: diamine; hydrazine monohydrate; hydrazine base; diamide

Description: A colorless, fuming, oily liquid with fishy or ammonia-like odor.

Fire Hazard: A dangerous fire hazard. Explosive limits are 4.7 to 100 percent; flash point is  $52^\circ\text{C}$  ( $126^\circ\text{F}$ ). It is a severe explosion hazard, and a highly reactive reducing agent. It may ignite spontaneously in air when in contact with porous materials, e.g., earth, asbestos, wood, or cloth. Extinguish fires with dry chemical, alcohol foam, or  $\text{CO}_2$ . Then flood with water to prevent re-ignition.

Toxicity: Hydrazine is a high inhalation, ingestion, and skin absorption hazard. It is highly irritating and corrosive on contact, and as a systemic poison can damage liver tissue and red blood cells. It also depresses the central nervous system. Animal tests have produced lung and lymph gland tumors.

Inhalation - It is recommended that exposure to the vapors not exceed 1 part per million parts of air (ppm) averaged over an 8-hour work period. Its odor can be detected as low as 3 to 5 ppm until olfactory fatigue sets in. Irritating to mucous membrane.

Skin - It can be absorbed through the intact skin and act as a systemic poison. In higher concentrations it can produce severe, penetrating damage by corrosive action. Skin sensitization can also occur.

Ingestion - Systemic poisoning symptoms are usually delayed following ingestion.

Eyes - Permanent corneal opacities can occur on contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Immediately flush with plenty of water for at least 15 minutes

Skin - Wash with plenty of soap and water.

\*Treat burns as thermal burns.

\*Ingestion - Administer gastric lavage followed by saline catharsis. Do not induce vomiting.

\*General - Administer barbiturates to control convulsions.

Personnel Protection: Wear rubber gloves, rubber lab apron, and chemical goggles. If vapors cannot be maintained below safe levels by containment and ventilation, e.g., during a spill, wear self-contained respirator.

**Storage:** Provide an inert gas (nitrogen) atmosphere over the hydrazine in a closed vessel. Store it separate from oxidizing agents such as acids and peroxides.

**Spill Control:** Deluge the spill area with large amounts of water and flush the diluted mixture (below 40 percent) to a catch basin. This can then be carefully added to a ferric salt solution and then disposed to a drain.

**Chemical Incompatibility:** Hydrazine can form unsafe combinations with air, alkali metals mixed with ammonia, chlorine, chromate, cupric oxide, cupric salts, peroxides, fluorine, nitric acid, nitrous oxide, oxygen, potassium dichromate, and metal oxides.

## HYDROCHLORIC ACID

Chemical Formula: HCl

Synonyms: hydrogen chloride acid; chlorohydric acid; muriatic acid  
(an impure form)

Description: A clear, colorless or yellowish liquid with sharp, irritating odor.

Fire Hazard: Not combustible but contact with common metals can produce hydrogen which may form explosive mixtures with air. Use water on fires involving HCl.

Toxicity: A high health hazard through exposure by contact, ingestion, or inhalation.

Inhalation - Exposure to the airborne vapors should not exceed 5 parts per million parts of air at any time. Very irritating to the nose, throat, and lungs producing edema and destruction of lung tissue, pneumonia, and perforations of the nasal septum and respiratory tract. 1500 ppm can be fatal in a few minutes of exposure; 35 ppm is irritating.

Ingestion - Tissue destruction, gastrointestinal distress, and pain can lead to death from circulatory shock, asphyxia due to swelling, perforation of the stomach, or infection.

Skin and eye contact - Very dangerous to the eyes due to tissue destruction. Skin irritation and ulceration can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes. Get medical attention.

\*Skin - Wash with plenty of cold running water for 15 minutes. Do not attempt to neutralize with alkalies since this will generate heat and add to the distress. Acid burns can be treated with saturated solution of sodium bicarbonate.

\*Ingestion - Avoid lavage or emetics. Administer, by mouth, diluants such as water and neutralizer such as milk of magnesium in large quantities, followed by demulcents such as milk or olive oil. Wash mouth out with water or sodium bicarbonate solution.

\*General - Opiates to relieve pain. Subsequent treatment is symptomatic and supportive, with bed rest.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If vapors cannot be kept below safe levels by containment and ventilation, e.g., during a spill, wear self-contained respirator.

Storage: Store in a cool, well-ventilated place separate from oxidizing substances.



Spill Control: Dilute with plenty of water and then add solid sodium bicarbonate or soda ash - slaked lime mixture (50-50). Wash down the drain with excess water. Wash the spill site with soda ash solution.

Chemical Incompatibility: HCl can be dangerous in contact with acetic anhydride, 2-aminoethanol, hydroxides, calcium phosphide, ethylene diamine, oleum, perchloric acid, propiolactone, propylene oxide, sulfuric acid, and vinyl acetate.

## HYDROFLUORIC ACID

Chemical Formula: HF

Synonyms: fluorhydric acid, hydrogen fluoride acid

Description: Colorless to green liquid; anhydrous acid is commercially available at 99 percent concentration; aqueous solutions range from 30 to 80 percent HF; the acid emits fumes at greater than 48 percent concentration. Difficult to contain as it corrodes most substances, except lead, wax, polyethylene, and platinum.

Fire Hazard: Not flammable but in contact with some metals it may generate explosive mixtures of hydrogen with air. Use water on fires in which HF is involved.

Toxicity: HF acid is extremely irritating and corrosive, producing chemical and thermal burns on contact, or by ingestion or inhalation of the vapors. Slowly healing ulcers result. It is also a direct systemic poison.

Inhalation - Exposure to the vapors should not exceed 3 parts of vapor per million parts of air (ppm) averaged over an 8-hour work period, and not to exceed 5 ppm at any time - except 10 ppm is permitted for not more than 30 minutes a day. 50 ppm is irritating and 1000-1500 ppm is lethal in 5 to 30 minutes. Prolonged exposure results in lung, liver, and kidney damage.

Ingestion - Gastro-intestinal damage, shock, cardiac collapse, respiratory arrest, and death can result from swallowing the liquid.

Skin and eye contact - Dangerous in contact with the eye; results in corneal damage and possible immediate loss of vision. Skin contact results in ulceration and if not thoroughly removed deep painful burns can result over several days. Gangrene has resulted from continuing contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked below with (\*) are for medical personnel and are not first aid action items.

Eyes - Flush with large amounts of water immediately; seek medical help.

Skin - Wash with cold water until skin regains normal color (up to several hours may be required). (\*) Follow with magnesium oxide paste. Detailed treatment procedures can be found in the literature.

\*Ingestion - Gastric lavage with 5 percent  $\text{CaCl}_2$  followed by saline catharsis. This can be preceded with dilution with large amounts of water followed with milk or milk of magnesium. Detailed treatment can be found in the literature. Do not induce vomiting.

\*Inhalation - Provide 100 percent oxygen under positive pressure for 30 minutes of every hour for 3 to 6 hours.

**Personnel Protection:** Wear neoprene gloves and apron, lab coat, and chemical goggles or face shield. If vapors cannot be maintained below safe levels by containment and local ventilation, e.g., during a spill, wear self-contained respirator.

**Spill Control:** Cover the spill area with sodium bicarbonate or a soda ash-slaked lime mixture (50-50). Mix and add water if necessary to form a slurry. Scoop up the slurry and wash down the drain with excess water. Wash spill site with soda ash solution.

**Disposal:** To dispose of small amounts, neutralize with powdered calcium carbonate, let stand for several hours, and wash down the drain with plenty of water.

## HYDROGEN BROMIDE GAS

Chemical Formula: HBr

Synonym: hydrobromic acid gas

Description: A colorless, nonflammable gas with a stinging odor.

Toxicity: Hydrogen bromide is highly toxic by ingestion, inhalation, or by contact. As little as 1 gram intake has been a cause of death.

It is highly irritating and corrosive to tissues and inhalation of toxic concentrations produces lung damage and edema. Exposure should not exceed 3 parts of gas per million parts of air.

Contact Medical Services if overexposure to the gas is suspected.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush eyes with plenty of water

Skin - Wash with soap and water.

Storage: Segregate from all oxidizing materials in a cool, well-ventilated area. Prevent contact with metals, woods, and textiles.

Personnel Protection: Where contact with the gas is possible, e.g., during a leak, wear rubber protective clothing and full-face self-contained respiratory equipment. Use fume hood when working with HBr.

Chemical Incompatibility: HBr is especially hazardous in contact with ammonia, and with ozone. Halogenated compounds in general can form unsafe combinations with inorganic acids, caustics, amines, olefins, and cyanohydrins.

## HYDROGEN CHLORIDE GAS

Chemical Formula: HCl

Synonyms: anhydrous hydrochloric acid, chlorohydric acid gas

Description: clear, colorless to slightly yellow gas which forms dense white fumes when exposed to air (hydrochloric acid mist), with irritating sharp odor and acid taste.

Fire Hazard: Not combustible but contact with common metals produces hydrogen which may form explosive mixtures with air. Container may explode due to overheating. Use dry chemical or CO<sub>2</sub> on small fire and water spray or fog on large fire.

Toxicity: This gas is a high health hazard primarily by inhalation and contact. It acts as an extreme irritant.

Inhalation - Exposure should not exceed 5 parts of gas per million parts of air (ppm) at any time. 5 to 10 ppm produces a disagreeable, sharp odor and acid taste. The gas is very irritating to the nose, throat, and lungs. More than 100 ppm causes lung edema and laryngeal spasm and 1000 to 2000 ppm is dangerous to life for even brief exposures, due to lung injury. Prolonged exposure discolors and erodes the teeth.

Skin and eye contact - The gas is very dangerous to the eyes at higher concentrations, causing conjunctivitis and corneal damage. It is a skin irritant.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes. Do not rub affected skin.

\*Inhalation - Opiates to relieve pain; rest. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Where contact with the gas is possible, e.g., during a leak, wear rubber protective clothing and full-face self-contained breathing apparatus. Use fume hood when working with this gas.

Chemical Incompatibility: HCl gas is especially hazardous in contact with calcium carbide, cesium carbide, lithium silicide, magnesium bromide, mercuric sulfate, and sodium. Halogenated compounds in general can form unsafe combinations with inorganic acids, caustics, amines, olefins, and cyanohydrins.

## HYDROGEN FLUORIDE GAS

Chemical Formula: HF

Synonyms: fluorohydric acid gas

Description: Colorless gas with sour taste; sharp, irritating odor.

Fire Hazard: Not combustible but if it is involved in a fire use dry chemical or CO<sub>2</sub> for small fire and water spray or fog for large fire.

Toxicity: HF gas presents a high health hazard as a severe respiratory irritant or when in contact with eyes or skin. It is also a direct, systemic poison.

Inhalation - Exposure to the gas should not exceed 3 parts of gas per million parts of air (ppm) averaged over an eight-hour work period, and not to exceed 5 ppm at any time -- except 10 ppm is permitted for not more than 30 minutes a day. 50 ppm is irritating, and dangerous for even short exposures and 1000 to 1500 ppm is lethal in 5 to 30 minutes. Prolonged exposure results in deep ulceration in the respiratory tract and in lung, liver, and kidney damage.

Skin and eye contact - Dangerous in contact with the eye; results in conjunctivitis and corneal damage. 120 ppm is irritating to the skin and eyes. Skin contact can result in ulceration, and burns.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked below with (\*) are for medical personnel and are not first aid action items.

Eyes - Flush with large amounts of water immediately.

\*Skin - Wash with plenty of cold water until skin returns to normal color, if exposure resulted in whitening of surface. Follow by swabbing with a 2.8 percent solution of aqueous ammonia.

\*Inhalation - Provide 100 percent oxygen under positive pressure for 30 minutes of every hour for 3 to 6 hours. Enforce bed rest for 24 hours.

\*General - The medical literature provides considerable detail on treatment for HF inhalation, ingestion and burns.

Personnel Protection: Maintain work area concentration of gas below safe levels by containment and use of fume hood. Wear chemical goggles or face shield, and rubber protective clothing. If gas exceeds safe levels, e.g., during a leak, wear a self-contained breathing apparatus.

Storage: Store in a well-ventilated area separated from other storage.



Chemical Incompatibility: HBr is especially hazardous in contact with ammonia or ozone. Halogenated compounds in general can form unsafe combinations with inorganic acids, caustics, amines, olefins, and cyanohydrins.

## HYDROGEN PEROXIDE

Chemical Formula:  $\text{H}_2\text{O}_2$

Synonyms: hydrogen dioxide; T-Stuff; peroxide; albone; superoxol; hydroperoxide

Description: A clear, heavy, water-like, colorless liquid with a slightly sharp odor.

Fire Hazard: Not flammable but may cause fire and explosion on contact with combustibles and some metals. Container may explode if heated. Mechanical shock may cause explosion. Use water to fight fires. Other agents will probably not be effective.

Toxicity: Concentrated solutions are highly toxic as a contact irritant.  $\text{H}_2\text{O}_2$  presents a health hazard also when swallowed or when the vapors, dispersed in air, are breathed.

Inhalation - Exposure to airborne vapor (90 percent solution concentration) should not exceed one part per million parts of air averaged over an 8-hour work period. Lung damage can result from breathing high concentrations.

Ingestion - Swallowing the liquid can result in inflammation and ulceration of the esophagus and stomach.

Skin and eye contact - Concentrations of 35 percent can blister and seriously burn the skin. A stinging sensation is felt and the exposed area turns white. Contact with the eyes by either the liquid or vapor can cause severe delayed damage, including conjunctivitis and corneal burns.

Treatment of Overexposure: Contact Medical Services.

NOTE: Sections marked (\*) are for the attention of medical personnel, and are included here only for information, not for first aid actions.

Eyes - Flush with water for at least 15 minutes. Contact Medical Services.

\*Skin - Wash with water followed by soap and water washing.

Treat any burn in the same manner as a thermal burn. Remove contaminated clothing and shoes.

\*General - Any additional treatment is supportive and symptomatic.

Ingestion - Wash out mouth with water and give plenty of water to drink.

Personnel Protection: Wear rubber gloves, lab coat, and face shield.

If containment and ventilation are not adequate to maintain vapors below safe levels, e.g., in a spill, wear self-contained breathing apparatus or appropriate chemical cartridge respirator.

Storage: Store in well-ventilated, cool location free of direct sunlight.

Spill Control: Cover spill area with at least a double volume of sand-soda ash mixture (90 percent-10 percent). Mix thoroughly and break up any lumps of peroxide. With a plastic scoop slowly add the mixture to a large beaker of sodium sulfite solution with stirring. Neutralize (litmus) with dilute sulfuric acid. When settled, decant the sulfate solution into a drain with excess water.

Chemical Incompatibility:  $H_2O_2$  is dangerous by chemical reaction with flammable materials or some metals, e.g., magnesium, copper, iron, zinc, or with aluminum powders. Also, with many other chemicals including acetic acid, acetic anhydride, aniline, acetone, antimony trisulfide, alcohol, cellulose, copper sulfide, ferrous sulfide, glycerine, cellulosic materials, ketones, nitromethane, hydrazine, lead oxides, lead sulfide, mercury oxides, molybdenum disulfide, nitric acid, potassium, potassium permanganate, sodium, sodium iodate, and thiodiglycol.

## HYDROGEN SULFIDE

Chemical Formula:  $H_2S$

Synonyms: sulfuretted hydrogen; hydrosulfuric acid; stink damp; sour gas

Description: Colorless, flammable gas with an offensive (rotten egg) odor at low concentrations and sweetish odor at high concentrations. Odor detectable at less than 1 ppm.

Fire Hazard: Dangerous when exposed to heat or flame. When heated to decomposition it emits highly toxic fumes. Explosive from 4.3 percent to 46 percent by volume in air. Extinguish fire using  $CO_2$ , dry chemical or water spray, or if it can be safely done, let a small fire burn.

Toxicity: Hydrogen sulfide is both an irritant and an asphyxiant, and is a rapid, powerful systemic poison, marked by respiratory paralysis. High concentration can cause almost immediate death.

Inhalation - Exposure to  $H_2S$  gas should not exceed a suggested limit of 20 parts per million parts of air (ppm) except that 50 ppm is permitted for not more than a ten-minute period. The odor is detectable at less than one ppm but the sense of smell is quickly dulled at higher concentrations. 600 ppm causes unconsciousness in less than two minutes; higher concentrations may cause rapid death due to respiratory paralysis. 20 to 150 ppm is irritating to the respiratory tract and prolonged exposure may injure the lungs.

Eyes - Concentrations above 20 ppm are irritating to the eyes and may cause conjunctivitis and injury to the cornea due to surface erosion.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are not for first aid action.

\*Eyes - Flush with water; then instill olive oil

Skin - Wash with soap and water

\*Inhalation - Administer oxygen and artificial respiration if necessary. Due to respiratory paralysis this may require several hours.

\*General - Sedate, but avoid respiratory depressants. Subsequent treatment is symptomatic and supportive. The appearance of effects of contact or inhalation may be delayed.

Personnel Protection: Maintain work environment below safe levels by containment and/or ventilation. When concentration exceeds this level, e.g., during a leak, evacuate personnel and wear self-contained respiratory protection to enter area.

Storage:  $\text{H}_2\text{S}$  should be stored in a cool, well-ventilated noncombustible location away from all sources of ignition. Store away from nitric acid, strong oxidizing materials, corrosive liquids, or sources of ignition. Protect from direct sunlight and excessive heat.

Leak Control: Bubble the leaking gas through a  $\text{FeCl}_3$  solution. Include a trap in the line to prevent the solution from being sucked back into the cylinder. Or, if it can be safely done, place the cylinder in a fume hood and allow it to bleed off.

Disposal: Small amounts may be flared, or burned at an approved disposal site.

Chemical Incompatibility:  $\text{H}_2\text{S}$  can be dangerous in combination with acetaldehyde, bromine pentafluoride, chloride monoxide or trifluoride, chromic anhydride, copper, fluorine, lead dioxide, nitric acid, nitrogen iodide, nitrogen trichloride or trifluoride, soda lime, and sodium peroxide.

## HYDROQUINONE

Chemical Formula:  $C_6H_4(OH)_2$

Synonyms: 1,4-benzenediol; 1,4-dihydroxybenzene; p-dihydroxybenzene; hydrochinone; quinol; arctuvín; p-benzenediol; benzohydroquinone; benzoquinol; tenox HQ; tequinol; eldoquin; hydroquinol; paradi-phenol; tecquinol; dioxybenzene p-hydroxyphenol

Description: A white or colorless crystalline solid with hexagonal prisms and sweet taste. In moisture it oxidizes to the more volatile quinone.

Toxicity: Hydroquinone is a moderate to highly toxic systemic poison by ingestion, inhalation, and contact exposures. It can affect the skin, blood components, internal organs, and central nervous system. Symptoms of poisoning include depigmentation of skin and eyes, respiratory difficulties, anemia and other blood cell changes, loss of muscular reflexes, kidney and liver damage, hypersensitivity to stimuli, delirium, coma, and respiratory failure.

Skin - Contact with the skin can cause dermatitis and allergic reaction. It is possibly a cause of warts.

Eyes - Chronic exposure has caused small corneal opacities and brown discolorations, loss of visual acuity, and conjunctivitis; acute exposures have caused corneal ulceration.

Inhalation - Exposure to airborne dusts and vapors should not exceed 2 milligrams per cubic meter of air averaged over an 8-hour work period.

Ingestion - Swallowing as little as one gram causes systemic poison symptoms, gastroenteritis, respiratory difficulties, cyanosis, and other difficulties. From 2 to 12 grams have proved fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items below marked (\*) are for the attention of medical personnel and included for information only, not for first aid action.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage followed by saline catharsis and demulcents.

\*General - Further treatment is supportive and symptomatic. Positive-pressure oxygen therapy and artificial respiration may be necessary as indicated.

Personnel Protection: Keep airborne dust levels below recommended limits by containment and ventilation. If levels exceed safe limits, e.g., during a spill, wear an approved mechanical filter respirator. Wear chemical goggles, lab coat, and rubber gloves. In case of a fire, use water,  $CO_2$ , or dry chemical.



Storage: Close container tightly and store away from direct sunlight.

Spill Control: Sweep spill onto paper and package in a cardboard container. Burn in an approved disposal area.

Chemical Incompatibility: It can form unsafe combinations with sodium hydroxide.

## INDOLE

Chemical Formula:  $(\text{CH})_4\text{C}_2(\text{CH})_2\text{NH}$

Synonyms: 1 - azaindene; 1-benzazole; 2,3-benzopyrrole; ketole;  
1-benzo-betapyrrole

Description: White to yellowish scales turning red on exposure to light and air. It has a pleasant odor in low concentration but unpleasant in high concentration.

Toxicity: Indole has low toxicity as a poison but is capable of causing tumors and is considered to be a cause of cancer.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses.

Spill Control: Collect in a cardboard container. Burn at an approved disposal site. Wash the spill site with strong soap solution. Contaminated clothing should be washed in a strong soap solution before wearing again. Contaminated shoes should be destroyed by burning.

## IODINE

Chemical Formula:  $I_2$

Description: A solid with heavy, grayish-black granules, scales, or plates; metallic luster and characteristic odor; readily sublimates producing violet vapors.

Toxicity: Iodine is highly toxic by ingestion and inhalation, it is also strongly irritating to the eyes and skin on contact. It is a central nervous system depressant.

Inhalation - Exposure to airborne vapors should not exceed 0.1 parts per million parts of air, averaged over any eight hour period. Irritation limits the concentration which can be breathed, producing pulmonary edema deep in the lungs. It is more irritating than chlorine or bromine.

Eyes and skin contact - Strongly irritating. It can be absorbed into the body through contact with the skin. Eye contact can result in loss of the corneal epithelium; this heals in 2 to 3 days. Skin exposure can result in acne and impetigo.

Ingestion - Intake of 2 to 3 grams can be fatal since it is extremely corrosive to the gastrointestinal tract producing shock and gastroenteritis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes and skin contact - Flush with water for at least 15 minutes.  
(\*)Wash skin with 5 percent sodium thiosulfate solution.

\*Ingestion - Promptly have victim swallow milk, starch, flour, or eggs; starch paste is excellent; administer gastric lavage with 1 to 10 percent starch in water or 1 percent sodium thiosulfate followed by saline catharsis.

\*General - Administer oxygen therapy by positive pressure, intermittent method if lungs are affected; correct any dehydration. Further treatment (e.g., for shock) is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield, or chemical goggles, and lab coat. When concentration of airborne dust may exceed safe levels, e.g., in cleaning up a spill, wear an approved chemical cartridge respirator.

Storage: Store in a cool dry area out of direct sunlight and separate from combustibles.

Spill Control: Cover spill with a reducer (hypo, a bisulfite, or a ferrous salt - but not carbon, sulfur, or a strong reducing agent). Mix well and spray with water. A sulfite or ferrous salt will require addition of some 3M  $H_2SO_4$  to promote rapid reduction. Scoop

slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash the spill site thoroughly with a soap solution containing some reducer.

Chemical Incompatibility: Iodine can form unsafe combinations with acetaldehyde, acetylene, aluminum, ammonia, ammonia hydroxide, antimony, chlorine, chlorine trifluoride, fluorine, lithium, potassium, sodium hydride, zirconium dicarbide, ethyl alcohol, lithium carbide, sodium hydroxide or phosphorus.

## ISOPROPYL ALCOHOL

Chemical Formula:  $\text{CH}_3\text{CHOHCH}_3$

Synonyms: isopropynol; isohol; lutosol; Petrohol; propan-2-ol; Perspirit; "rubbing alcohol"; dimethylcarbinol; sec-propyl alcohol; Avantine; carbinol; 2-propanol

Fire Hazard: Dangerous fire hazard when exposed to heat; flash point, 12° C (53° F); explosive range 2 percent to 12 percent by volume. Extinguish fires with alcohol foam. Water spray is not effective.

Toxicity: A moderate ingestion and inhalation hazard, and slight contact hazard. In high concentrations acts as a narcotic and depresses the central nervous system.

Inhalation - Exposure to airborne vapors should not exceed 400 parts per million parts of air averaged over an eight-hour work period. It provides good warning properties due to irritating effects on eyes, nose, and throat.

Skin and Eyes - Acts as a local irritant and can be absorbed to some degree through the intact skin. Can produce conjunctivitis and corneal ulceration.

Ingestion - Eight ounces have been lethal to man when swallowed. Gastrointestinal disturbance and pain result, leading to respiratory arrest, coma, and cardiac disturbance.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with plenty of water

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage with water followed by saline catharsis.

\*General - Administer oxygen and artificial respiration as needed. Administer IV glucose and saline. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If vapors cannot be maintained below safe levels by containment and local ventilation, such as during a spill, wear the appropriate chemical cartridge respirator.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill on paper towels and evaporate to dryness in a fume hood.

Chemical Incompatibility: Hazardous in contact with oleum, phosgene, potassium tertiary butoxide, and nitroform. Alcohols in general form unsafe combinations with inorganic acids, aldehydes, esters, alkylene oxides, halogens, and acid anhydrides.

## KEROSENE

**Description:** A mixture of petroleum hydrocarbons chiefly of the methane series. A pale yellow to water-white oily liquid.

**Synonyms:** kerosine; fuel oil no. 1

**Fire Hazard:** Kerosene is a moderate fire hazard when exposed to heat. Combustible, with a flash point of from 38 to 74° C (100 to 165° F) and explosive limits of 0.07 to 5.0 percent in air. Extinguish fires with foam, CO<sub>2</sub>, or dry chemical.

**Toxicity:** Kerosene is moderately toxic by inhalation, skin contact, and ingestion. It depresses the central nervous system, is a local irritant, can affect heart action, and as a systemic poison cause lesions in internal organs. It is a recognized carcinogen (cancer-forming) of skin, lung, and alimentary tract.

Inhalation - Due to its low volatility it is not normally a breathing hazard under normal work conditions. However, if the liquid is aspirated into the lungs fatal bronchopneumonia can result. Exposure to the vapors should not exceed 1000 parts per million parts of air averaged over an eight-hour work period.

Skin and eye contact - Liquid contact can produce dermatitis and conjunctivitis.

Ingestion - Swallowing 3 to 4 ounces has proved to be fatal to man. It is irritating to the gastrointestinal system.

**Treatment of Overexposure:** Contact Medical Services immediately.

**NOTE:** Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with plenty of water.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Never administer emetics. Vomiting can cause aspiration of the liquid into the lungs. Administration of 30 ml. of syrup of ipecac followed by 200 to 500 ml. of water has proved helpful. If vomiting has occurred, saline cathartic is useful. If lung involvement is suspected steroids may be beneficial.

**Personnel Protection:** Wear rubber gloves, lab coat, and chemical goggles. When adequate vapor control is not possible, e.g., during clean-up of a spill, wear an approved chemical cartridge respirator.

**Spill Control:** Eliminate any sources of ignition. Absorb spill on paper toweling and evaporate to dryness in a fume hood.



Storage: Keep storage containers tightly closed. If possible store in a standard combustible liquids storage cabinet or room.

Disposal: Dispose of at an approved disposal site by pouring on dry soil and igniting with caution.

## LEAD ACETATE

Chemical Formula:  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2) \cdot 3\text{H}_2\text{O}$

Synonyms: Acetic acid, lead salt; sugar of lead; lead diacetate; salt of saturn

Description: White transparent crystals; commercial grade may be brown or gray lumps with odor of acetic acid; weak sweet taste.

Toxicity: It is a high ingestion and inhalation hazard. Systemic poisoning by absorption through the intact skin is also possible. The poisonous effects are cumulative, large in number, and severe. Chronic poisoning can produce alimentary distress, neuromuscular symptoms, or central nervous system damage including lesions in the brain. It is suspected to be a cause of cancer.

Inhalation - Exposure to airborne vapors should not exceed a suggested limit of 0.2 milligrams per cubic meter of air averaged over an 8-hour work period. Inhalation is the most important route of uptake.

Ingestion - Toxic effects may not be evident for up to 45 days following ingestion. Greater than 30 grams can be fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water

Skin - Wash w' th soap and water

\*Ingestion - Administer gastric lavage with 1 percent solution of  $\text{Na}_2\text{SO}_4$  or  $\text{MgSO}_4$ . Leave 15 to 30 grams in 6 to 8 ounces of water in the stomach as an emetic. Administer demulcents such as milk or egg white.

\*General: Longer term "De-leading" of the system involves administering  $\text{Ca}(\text{EDTA})$  intravenously over a prolonged course of treatment. This is described in detail, along with additional treatment, in the literature.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. If airborne dust levels cannot be maintained below safe levels, e.g., during clean-up of a spill, wear the appropriate mechanical filter respirator. Wash hands after working with the material.

Spill Control: Cover a liquid solution spill area with soda ash mix, and scoop into a beaker of water; neutralize with 6M-HCl and wash down the drain with excess water. For a solid material spill, collect the material in a beaker, dissolve in a large amount of water, add soda ash, and dispose as above.

Chemical Incompatibility: Lead acetate forms a dangerous combination with potassium bromate.

## LEAD COMPOUNDS

**Toxicity:** The soluble compounds of lead are moderately to highly poisonous and enter the body chiefly by inhalation, ingestion, and often by skin absorption also. It is one of the most toxic metals because it accumulates in the body and its toxic effects are many and severe. The effects are threefold: (1) alimentary with stomach distress and cramps; (2) neuromuscular, (especially in adults) with convulsions, dizziness, paralysis, weakness; (3) cerebral (especially in children) with central nervous system depression, delusions, coma.

Inhalation - A high toxicity by easy, ready absorption through the lungs into the blood stream. Exposure should not exceed 0.2 milligrams per cubic meter of air, averaged over an 8-hour work period.

Ingestion - Less readily absorbed but still a toxic hazard. The minimal lethal dose is believed to be 10 grams.

Skin contact - Absorption through the intact skin readily occurs in many soluble lead compounds.

**Treatment of Overexposure:** Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with plenty of water

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage or initiate vomiting; follow with saline catharsis and enema. Give calcium gluconate, atropine, or other antispasmodic for relief of colic.

\*General - Therapy is complicated and involved. It aims at preventing absorption by the alimentary canal, and promote elimination from the body. This is discussed in detail in the literature.

**Personnel Protection:** Handle powders of lead compounds in closed systems or within a fume hood. Practice good housekeeping and personal hygiene. No smoking or eating in the work area. Wear rubber gloves, lab coat, and safety glasses. Where airborne dust may exceed safe limits, e.g., in cleaning up a spill, wear an approved mechanical filter respirator.

**Spill Control:** Cover a liquid spill with soda ash, mix and scoop into a beaker of water; neutralize with 6M-HCl and wash down the drain with excess water. For a solid spill collect the material in a beaker, dissolve in a large amount of water, add soda ash, and dispose of as above.

## LEAD NITRATE

Chemical Formula:  $\text{Pb}(\text{NO}_3)_2$

Synonym: nitric acid, lead salt

Description: A white crystalline solid

Fire Hazard: In contact with easily oxidizable substances, it may react rapidly enough to cause ignition, violent combustion, or explosion. It decomposes at  $210^\circ \text{C}$  ( $410^\circ \text{F}$ ) to release toxic gaseous oxides of nitrogen. Use flooding amounts of water in fighting a fire. It promotes combustion of inflammables.

Toxicity: Lead nitrate is a high health hazard as a systemic poison. Its effects are cumulative. It depresses the central nervous system and can produce coma and death when absorbed in large enough a dose.

Inhalation - Exposure to the airborne dust or vapor should not exceed 0.2 milligrams per cubic meter of air averaged over an eight-hour work period. When inhaled, it is readily absorbed in the bloodstream.

Ingestion - When swallowed, it is irritating to the gastrointestinal tract. Toxic amounts can be ingested due to contamination on food, tobacco, or other objects taken into the mouth. Absorption into the body as a systemic poison follows. The minimum lethal dose is about 10 grams.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are included here for information, not for first aid actions.

Eye and skin contact - Flush with running water

\*Ingestion - Administer gastric lavage with 1 percent sodium sulfate followed by catharsis and demulcents.

\*General - Additional treatment includes intravenous injection of chelating agents and is detailed in the literature.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. If airborne dust levels cannot be maintained below safe levels, e.g., during clean-up of a spill, wear the appropriate mechanical filter respirator.

Storage: Store in a cool and dry place. Separate from organics and easily oxidizable materials.

Spill Control: Cover a liquid solution spill with soda ash, mix, and scoop into a beaker of water; neutralize with 6M-HCl and wash down the drain with excess water. For a solid material spill, collect the material in a beaker, dissolve in a large amount of water, add soda ash, neutralize and dispose of as above.

Chemical Incompatibility: Lead nitrate can form unsafe combinations with ammonium thiocyanate, carbon, and lead hypophosphite.

## LITHIUM HYDROXIDE

Chemical Formula: LiOH

Synonym: lithium hydroxide monohydrate

Description: Colorless crystals

Toxicity: As a systemic hazard, lithium hydroxide is a moderately toxic poison by ingestion or inhalation. It can produce kidney damage and may be irritating to the central nervous system. In higher concentration, it acts as a strong alkali corrosive directly on the tissues contacted, similar to lye in action.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Gently flush with warm running water for at least 15 minutes. Get medical attention.

Skin - Wash in fresh, running water for at least 15 minutes.

\*Treat the same as a thermal burn.

Ingestion - Dilute by immediately drinking large amounts of water or milk.

\*Neutralize with dilute vinegar or orange juice; do not give gastric lavage or emetics. Instill olive oil frequently. Administer demulcents.

\*General - Administer analgesics; further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: In solid form, sweep up, dilute with water and neutralize with 6M-HCl in a large container. In liquid solution form, neutralize and mop up. Wash the neutralized liquid down the drain with a large excess of water.

Chemical Incompatibility: In general, caustics, e.g., LiOH, form unsafe combinations with inorganic acids, organic acids, halogenated compounds, aldehydes, ketones, esters, phenols, cyanohydrins, nitriles, halogens, elemental phosphorus, and acid anhydrides.



## MALONIC ACID

Chemical Formula:  $\text{CH}_2(\text{COOH})_2$

Synonyms: carboxyacetic acid; dicarboxymethane; methane-dicarboxylic acid; ursolic acid

Description: white or colorless crystals

Toxicity: Malonic acid is highly toxic as a local irritant, by inhalation of the dust, and by ingestion. It is a strong acid and damaging to the tissues. It can also act as a systemic poison by inhibiting certain enzymes.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Flood with water and then wash with soap and water

Inhalation - Oxygen administration, if necessary. Additional treatment is symptomatic and supportive.

Ingestion - No information is available in the common sources of reference. Since the acid is caustic, immediately dilute by drinking water or milk followed by 200 ml of milk of magnesia.

Personnel Protection: Wear rubber gloves, lab coat, and face shield.

If containment and ventilation does not keep airborne dust concentrations below safe levels, e.g., during clean-up of a spill, wear an approved mechanical filter respirator.

Spill Control: Eliminate all sources of ignition. Cover the spill with soda ash or sodium bicarbonate. Mix, and add water. Scoop up the slurry and wash the neutral waste (litmus test) down the drain with excess water. Wash the spill site with soda ash solution.

Chemical Incompatibility: Organic acids generally form unsafe combinations with inorganic acids, caustics, amines, aldehydes, esters, alkylene oxides, cyanohydrins, nitriles, ammonia, and elemental phosphorus.

## MANGANESE

Chemical Formula: Mn

Synonyms: colloidal manganese

Description: A reddish-gray or silvery, brittle metal

Fire Hazard: A moderate fire hazard when exposed to heat as a dust or powder. Decomposes in water to evolve hydrogen. Extinguish fires with dry chemical extinguisher.

Toxicity: Manganese is an essential element for normal nutrition but taken into the body in excess either by inhalation or ingestion it is a poison and can produce total disablement by acute or chronic exposure.

Inhalation - Exposure to airborne dust or powder should not exceed 5 milligrams per cubic meter of air at any time. In concentrations in excess of 30 mg/m<sup>3</sup>, it can produce pulmonary injury, resulting in pleuritis or bronchopneumonia or the symptoms described below. It can also cause metal fume fever.

Ingestion - Exposure to toxic quantities can result in a host of symptoms due to injury to the brain cells, such as weakness, speech disturbance, loss of motor control and balance, muscular tremors, and fatigue. These effects may be permanent and crippling and usually occurs after long duration of exposure.

Skin - Contact can cause dermatitis.

Treatment of Overexposure: Contact Medical Services immediately. The information below is for the attention of medical personnel and is not for first aid action.

Ingestion - Administer gastric lavage followed by saline catharsis.

General - Treatment includes high calcium diet, liver extract, and vitamin C. The literature details further treatment in addition to supportive and symptomatic actions.

Personnel Protection: Wear lab coat, heavy gloves, and safety glasses. Ensure adequate ventilation to keep dust concentrations within safe levels. Wear an approved mechanical filter respirator when exposed to the dust, e.g., during spill clean-up. Wash after each work period and before eating.

Disposal: Turnings and cuttings may be assigned to landfill.

Chemical Incompatibility: Manganese can form unsafe combinations with aluminum and air, chlorine, fluorine, hydrogen peroxide, nitric acid, nitrogen dioxide, phosphorus, and sulfur dioxide.

## MERCURIC CHLORIDE

Chemical Formula:  $\text{HgCl}_2$

Synonyms: corrosive sublimate; bichloride of mercury, calochlor; mercury perchloride

Description: White crystals or powder

Toxicity: Extremely toxic by inhalation, ingestion, or absorption through intact skin. Poisoning effects are primarily on the central nervous system. Also corrosive to tissues on contact.

Inhalation - With normal handling, the principal hazard is inhalation of the vapors or dust. An exposure limit of 0.1 milligram per cubic meter of air averaged over an 8-hour work period has been suggested.

Ingestion - Absorption after ingestion is extremely rapid and the first ten to fifteen minutes of first aid is critical. Lethal oral dose is one-half to two grams.

Skin contact - Poisoning can occur by absorption through the intact skin. Prolonged contact can also produce dermatitis.

Eye contact - Can cause severe injury to the eye with conjunctivitis and ulceration of the cornea.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are included here for information, not for first aid action.

Eyes - Flush immediately with plenty of water for at least 15 minutes, then get prompt medical attention.

Skin - Wash with plenty of water

\*Ingestion - Act fast! Administer gastric lavage with egg white solution followed by emetic. Dimercapto - propanol (BAL) is an effective therapeutic agent but should be given within three hours for maximum effectiveness. Further detailed treatment is available in the literature.

\*Inhalation - Oxygen administration may be required for heavy exposure. BAL therapy is indicated. Keep victim warm and quiet.

Personnel Protection: The most important single control measure is good housekeeping. Wear rubber gloves, safety goggles, and lab coat. Respirators designed specifically for mercury or self-contained respiratory equipment should be used when permissible airborne concentrations may be exceeded. Wash hands thoroughly before eating or smoking.

Storage: Keep containers tightly closed and store in a well-ventilated location. Polyethylene containers are suitable for small quantities.

Spill Control and Disposal: Precipitate as mercuric sulfide by adding sodium bisulfite. Dry the precipitate and investigate possibility of reclaiming the mercury.

Chemical Incompatibility: Forms unsafe combinations with potassium, sodium, phosphorous, antimony, acetylene, and ammonia when heated.

## MERCURIC NITRATE

Chemical Formula:  $\text{Hg}(\text{NO}_3)_2$

Synonyms: mercury (I) nitrate

Description: A white-yellowish deliquescent powder

Fire Hazard: When heated to decomposition, it emits highly toxic fumes

Toxicity: A high health hazard whether by inhalation, ingestion, or skin contact. A systemic poison, mercuric nitrate acts primarily through the central nervous system, but with many other physical effects. Psychic disturbance, tremors, convulsion, and death due to vascular collapse or kidney failure can result.

Inhalation - In addition to the above effects, cough, bronchitis, and pneumonitis can occur.

Ingestion - Tissue destruction in the mouth, throat and gastrointestinal system occur. The lethal oral dose of soluble mercury salts is 1 to 2 grams.

Eyes and skin contact - It can act as a poison by absorption through the intact skin. Dermatitis due to prolonged or repeated exposure has occurred. Eye contact results in ulceration of the conjunctiva and cornea.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Administer egg white and milk and induce vomiting; or gastric lavage with egg white solution or 2 to 5 percent sodium bicarbonate. BAL (dimercapto-propanol) is an effective therapeutic agent.

\*General - Treat for shock and provide symptomatic and supportive treatment. Keep victim warm and quiet.

Personnel Protection: Wear rubber gloves, safety goggles, and lab coat. Work in a fume hood. When the level of airborne dust may exceed safe levels, wear respirators designed specifically for mercury salts or self-contained respiratory equipment. Wash hands thoroughly before eating or smoking.

Spill Control and Disposal: Precipitate as mercuric sulfide by adding sodium bisulfite. Consider possibility of reclaiming the mercury.

Chemical Incompatibility: Mercuric chloride can form unsafe combinations with acetylene, ethyl alcohol, hypophosphoric acid, phosphine, sulfur, and aromatic hydrochlorides and unsaturated hydrochlorides.

## MERCUROUS CHLORIDE

Chemical Formula:  $\text{HgCl}_2$

Synonyms: Mercury monochloride; mercury chloride, mild; mercury protochloride; calomel; calogreen; mild mercury chloride.

Description: White rhombic crystals or powder which darken on exposure to light. Odorless.

Toxicity: A high health hazard by inhalation, ingestion, and by absorption through the intact skin. Overexposure can result in severe damage to the kidneys, liver, brain, heart, lungs and colon.

Ingestion - It is estimated that one to two grams can be lethal.

Low level absorption of small quantities can be cumulative in effect. It is an irritant and purgative.

Inhalation - Exposure to airborne dust should not exceed a suggested limit of 0.1 milligrams per cubic meter of air averaged over an 8-hour period. Acute poisoning can occur at 1.2 mg/M<sup>3</sup> of air.

Skin and Eyes - It is a skin irritant and can produce sensitization dermatitis. It can cause severe eye irritation.

Treatment of Overexposure: Contact Medical Service immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush immediately with plenty of water for at least 15 minutes, then get prompt medical attention.

Skin - Wash with soap and water.

\*Ingestion - Administer gastric lavage with a 5 percent solution of sodium formaldehyde sulfoxylate and follow with a 2 percent solution of sodium bicarbonate. Leave 250 ml of sodium formaldehyde sulfoxylate in the stomach after lavage.

\*General - Antidote with dimercaprol - additional treatment is supportive and symptomatic.

Personnel Protection: Maintain good housekeeping; clean up spills immediately. Provide local exhaust ventilation or work in a fume hood. Wear lab coat, rubber gloves and chemical goggles. If vapors or powders could become airborne in excess of permissible limits, wear an approved respirator designed for mercury. Never heat in the open - only in a fume hood.



## METHANOL

Chemical Formula:  $\text{CH}_3\text{OH}$

Synonyms: methyl alcohol; wood alcohol; wood naphtha; wood spirit; pyroxylic spirit; methyl hydroxide

Description: A colorless, clear, mobile liquid with a sweet odor detectable at 100 ppm to 2000 ppm.

Fire Hazard: A moderate fire hazard; explosive range from 6 percent to 36.5 percent in air. The flash point is  $12^\circ\text{C}$  ( $60^\circ\text{F}$ ). Extinguish with dry chemical, alcohol foam, or  $\text{CO}_2$ .

Toxicity: Methanol is a high toxic hazard by ingestion, and a moderate hazard by inhalation and through skin absorption. It acts as an irritant and a narcotic. It is a cumulative poison which forms formaldehyde and formic acid when metabolized. It can damage nerve cells, particularly the optic nerve, and produce degenerative changes in the kidney, liver, and heart.

Inhalation - Exposure to airborne vapors should not exceed a suggested limit of 200 parts per million parts of air (ppm) averaged over an eight-hour work period. 1000 ppm produces poison symptoms, 5000 ppm results in stupor, and 50,000 ppm can be fatal.

Ingestion - Two teaspoons ingested can be toxic and 2 to 8 ounces have resulted in death.

Skin and Eye Contact - Methanol is irritating to the mucous membrane and can cloud the vision by eye contact. It may be absorbed through the intact skin. It can cause dermatitis and conjunctivitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage with 3 to 5 percent sodium bicarbonate, leaving some solution in the stomach after lavage. Follow by 50 percent ethanol in water by mouth every 3 to 4 hours until acidosis is corrected. Treat for acidosis. Administer oxygen and artificial respiration, as necessary. The literature has additional detailed treatment.

\*General - Combat shock; administer stimulants if needed.

Personnel Protection: Wear gloves, face shield or chemical goggles, and lab coat. When airborne vapors cannot be maintained below safe levels by containment and ventilation, e.g., during spills, wear a self-contained breathing apparatus.

Storage: Store in a well-ventilated area, away from sources of ignition.

Spill Control: Eliminate all sources of ignition and flammables. Wash down the drain with large quantities of water.

Chemical Incompatibility: Unsafe combination can form with nitric acid, chromic anhydride, lead perchlorate, perchloric acid, and phosphorus trioxide. Alcohols in general can be unsafe in contact with inorganic acids, aldehydes, esters, alkylene oxides, halogens, and acid anhydrides.

## METHYL ACETYLENE

Chemical Formula:  $\text{CH}_3\text{CCH}$

Synonyms: allylene; propyne

Description: A colorless gas

Fire Hazard: A dangerous fire hazard when exposed to heat or flame. The lower explosive limit is 1.7 percent by volume in air. Extinguish fire by stopping the flow of gas or using dry chemical, water spray, or  $\text{CO}_2$

Toxicity: Methyl acetylene is a moderate inhalation hazard which depresses the central nervous system. It is also an irritant.

Inhalation - Exposure to the gas should not exceed 1000 parts per million parts of air averaged over an eight-hour work period. Higher concentrations act as a simple anesthetic and lung irritant, which could produce pneumonitis. No permanent effects result after exposure.

Treatment of Overexposure: Contact Medical Services. Treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves. If a leak occurs, eliminate all sources of ignition and flammables. Keep the concentration below the explosive mixture range by forced ventilation. Remove the container to an open area and allow dissipation to the atmosphere. Methyl acetylene can decompose explosively at 4.5 to 5.6 atmospheres pressure.

Storage: Store in a well-ventilated area away from sources of ignition.

## METHYL CHLORIDE

Chemical Formula:  $\text{CH}_3\text{Cl}$

Synonyms: monochloromethane; chloromethane

Description: A colorless, flammable, almost odorless (ethereal) gas with no distinctive warning properties; a slight odor is detectable at about 100 ppm.

Fire Hazard: Dangerous when exposed to heat, sparks, or fire. Explosive range from 10.7 to 17.2 percent in air; flash point less than  $0^\circ\text{C}$  ( $32^\circ\text{F}$ ). Heat of fire may produce irritating or poisonous gases. Cool exposed containers and extinguish small fires with dry chemical or  $\text{CO}_2$  and large fires with water spray or fog.

Toxicity: Methyl chloride is highly toxic by inhalation, acting as a central nervous system depressant. High concentrations can cause convulsions, coma, and death. Lower concentrations (as low as 500 parts per million parts of air - ppm) can produce stupor, incoordination, slurred speech, and vision problems, with recurrence of the symptoms after evident recovery. Exposure by inhalation should not exceed a ceiling of 200 ppm, and 100 ppm averaged over an eight-hour work period - except 300 ppm for five minutes in any three-hour period is permissible. Persons may be exposed to high concentrations without being aware of the danger. The onset of symptoms of poisoning may be delayed. Prolonged overexposure causes damage to the brain, liver, kidney, bone marrow, and cardiovascular system. The body metabolizes methyl chloride to methyl alcohol and hydrochloric acid.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: The information below is for the attention of medical personnel and is not for first aid action.

Hospitalize and treat for shock; administer oxygen and stimulants, if indicated. Combat acidosis. Further treatment is symptomatic and supportive.

Personnel Protection: Maintain air concentrations below safe levels by containment and ventilation. If leaks cause concentrations above safe levels, wear self-contained breathing apparatus. Wear gloves, face-shield, and lab coat to prevent contact with the liquid.

Storage: Store in a well-ventilated area at temperatures less than  $40^\circ\text{C}$  ( $104^\circ\text{F}$ ) and no exposure to direct sunlight.

Chemical Incompatibility: Unsafe combinations can result from contact with aluminum, magnesium, potassium, sodium, and sodium-potassium alloy. In general, halogenated compounds form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## METHYL CYANIDE

Chemical Formula:  $\text{CH}_3\text{CN}$

Synonyms: acetonitrile; cyanomethane; ethane nitrile; ethyl nitrile

Description: A colorless, limpid watery liquid with an aromatic odor and burning taste. The odor is detectable at about 40 ppm. Odor sensitivity is rapidly fatigued.

Fire Hazard: A dangerous fire risk with a flash point of  $5.5^\circ\text{C}$  ( $42^\circ\text{F}$ ). Flammable limits, 4.4 to 16.0 percent. Vapors may travel a considerable distance to an ignition source and flash back. The products of decomposition are highly toxic cyanides. Extinguish fire with dry chemical, alcohol foam, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: Methyl cyanide is highly toxic by inhalation, ingestion, and by absorption through the intact skin. It has insufficient warning properties to prevent working in a lethal atmosphere. Once in the system, it hydrolyses to cyanides.

Inhalation - Exposure to airborne vapors should not exceed 40 parts per million parts of air (ppm) averaged over an eight-hour work period. The sense of smell is rapidly dulled and cannot be relied on as a warning.

Skin - Contact with the skin produce dermatitis. It is rapidly absorbed through the skin to produce systemic poisoning.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush eyes with plenty of water for at least 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes

\*Ingestion - Induce vomiting. Have victim drink water or milk. Administer 1 percent solution of sodium thiosulfate.

\*General - For systemic poisoning, administer 10 cc of 3 percent sodium nitrite intravenously over a two minute period, then 50 cc of 25 percent sodium thiosulfate. Repeat at hourly intervals as required.

\*Further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If airborne vapors exceed safe limits, e.g., during a spill, evacuate the area and wear a self-contained breathing apparatus to clean up the spill.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the liquid with vermiculite or paper towels. Evaporate to dryness in a fume hood.

Disposal: Add the material with stirring to a strong alkaline solution of calcium hypochlorite. Maintain an excess of sodium hydroxide and calcium hypochlorite. Let stand for 24 hours. Flush the cyanate down the drain with a large excess of water. Carry out reaction in fume hood or out-of-doors to avoid exposure to the chlorine that is released.

Chemical Incompatibility: Dangerous when interacting with oleum, chlorosulfonic acid, sulfuric acid, and erbium perchlorate.



## METHYL CYCLOHEXANE

Chemical Formula:  $\text{CH}_3\text{C}_6\text{H}_{11}$

Synonyms: cyclohexylmethane; hexahydrotoluene; sextone B; toluene hexahydride

Description: A colorless liquid with a faint odor at 500 ppm

Fire Hazard: A dangerous fire hazard with a flash point of  $-40^\circ\text{C}$  ( $25^\circ\text{F}$ ), and an autoignition temperature of  $285^\circ\text{C}$  ( $545^\circ\text{F}$ ). The lower explosive limit is 1.2 percent in air. Extinguish fires with dry chemical, foam, or  $\text{CO}_2$ .

Toxicity: Methyl cyclohexane is moderately toxic by inhalation of the vapors and by ingestion of the liquid. It acts as a narcotic and anesthetic and in animal studies has caused kidney and liver damage.

Inhalation - Exposure to the vapors should not exceed 500 parts per million parts of air (ppm); 15,000 ppm for one hour has been lethal in animal studies.

Ingestion - Ingestion has produced circulatory collapse and muscular spasms in animal studies.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water

Skin - Wash with soap and water

Personnel Protection: Wear rubber gloves, safety goggles or face shield, or lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill with paper towels. Evaporate to dryness in a fume hood.

## METHYLENE CHLORIDE

Chemical Formula:  $\text{CH}_2\text{Cl}_2$

Synonyms: dichloromethane; methylene dichloride; solaesthin

Description: A clear, colorless, volatile liquid with a sweet penetrating odor detectable at about 300 parts per million parts of air (ppm)

Fire Hazard: Not flammable but poisonous gases are produced when heated. Cool fire-exposed containers with water.

Toxicity: Methylene chloride is highly toxic by inhalation of its vapors and moderately toxic by ingestion and skin absorption. It acts as a central nervous system depressant and narcotic and can be lethal in high concentrations.

Inhalation - Exposure to the vapors should not exceed 500 ppm averaged over an eight-hour work period, not to exceed 1000 ppm - except that 2000 ppm for 5 minutes in any two hours is permitted. At 5000 ppm detectable effects on the nervous system occur; lung irritation and edema also result from similar overexposures.

Ingestion - The same physical effects result from swallowing gram quantities. 25 grams is believed to be fatal.

Skin and eye contact - Repeated skin contact results in dry, cracked skin and dermatitis. If the spilled liquid is confined by clothing, painful irritation results. Eye contact is irritating and painful but no injury results.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with water for at least 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion and Inhalation - If ingested, administer gastric lavage followed by saline catharsis. Administer artificial respiration and oxygen therapy if necessary. Do not administer vasopressor drugs, e.g., epinephrine because of possible heart effects. Additional treatment is supportive and symptomatic. Treat burns to skin in the usual manner.

Personnel Protection: Wear rubber gloves, chemical goggles and lab coat. When containment and ventilation cannot keep vapor concentration below safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Storage: Store in a cool, dry, well-ventilated area.

Spill Control: Absorb spills with paper towels and evaporate to dryness in a fume hood.

Disposal: Use approved land-fill area for disposal.

Chemical Incompatibility: Dangerous when reacted with lithium, potassium tert.-butoxide, sodium-potassium alloy, nitrogen tetroxide, or liquid oxygen.

#### 4,4'-METHYLENEDIANILINE

Chemical Formula:  $\text{CH}_2(\text{C}_6\text{H}_4\text{NH}_2)_2$

Synonyms: bis (p-aminophenyl) methane; diaminodiphenylmethane; dianilinomethane; MDA; tonox; DDM

Description: Tan flakes or lumps

Toxicity: MDA is highly toxic by ingestion and is irritating on skin contact. It has been found to cause tumors of the kidney, liver, and uterus when administered by mouth to animals. It does not rapidly absorb through the intact skin. It is considered a moderately hazardous systemic poison producing toxic hepatitis and cirrhosis. Until further information is available it should be handled with care so that ingestion or skin contact is minimized. Dust inhalation should also be avoided.

Personnel Protection: Wear polyvinyl alcohol, or neoprene gloves, or latex gloves (if changed frequently), safety glasses, and lab coat. Contaminated clothing should be removed, dried, and washed in strong soap solution.

Spill Control: Brush solids onto paper and package in cardboard container. Burn at an approved disposal site. Wash spill site with strong soap solution.

Chemical Incompatibility: Aromatic hydrocarbons in general form unsafe combinations with inorganic acids, halogens, and molten sulfur.

## METHYL ETHYL KETONE

Chemical Formula:  $\text{CH}_3\text{COC}_2\text{H}_5$

Synonyms: ethyl methyl ketone; MEK; 2-butanone

Descriptions: Colorless, water-clear liquid with a sweet odor that is detectable at about 10 ppm

Fire Hazard: MEK is very volatile, and is considered a dangerous fire hazard when exposed to heat or flame. Flash point is  $-6^\circ\text{C}$  ( $22^\circ\text{F}$ ); explosive from 1.8 to 10 percent by volume in air. Extinguish fires with  $\text{CO}_2$  or dry chemical, or alcohol foam.

Toxicity: Produces local irritation and central nervous system depression and narcosis. The vapor is irritating to the mucous membrane and highly irritating to the eyes.

Inhalation - Exposure to airborne vapors should not exceed 200 parts per million parts of air (ppm) averaged over an eight-hour work period. Concentrations as low as 10 ppm can be detected by odor, but the sense of smell is rapidly dulled and cannot be relied on as a warning. High concentrations can cause temporary liver and kidney injury and narcosis. Over 10,000 ppm can be hazardous to life.

Ingestion - MEK has low toxicity effects when swallowed.

Skin - Contact with the liquid is extremely irritating and can produce skin burns; lower concentrations can cause dermatitis. Systemic poisoning does not occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush eyes with plenty of water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Gastric lavage followed by saline catharsis.

Inhalation - Administer artificial respiration and oxygen if necessary.

\*General - Subsequent treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. Use in laboratory fume hood. When adequate vapor control is not possible, e.g., spills, wear self-contained breathing apparatus or appropriate chemical cartridge respirator.

Storage: Store in cool location in tightly closed container.

Spill Control: Eliminate any sources of ignition. Absorb spill on paper towels and evaporate to dryness in a fume hood.

Disposal: May be burned in not more than 500 ml portions at an approved disposal site.

Chemical Incompatibility: In general, ketones can form unsafe combinations with inorganic acids, caustics, amines, ammonia, and halogens.



## METHYL HYDRAZINE

Chemical Formula:  $\text{CH}_3\text{NHNH}_2$

Synonyms: monomethyl hydrazine; MMH

Description: A clear, colorless liquid with an ammonium-like odor

Fire Hazard: A dangerous fire hazard with a flash point of  $16^\circ\text{C}$  ( $61^\circ\text{F}$ ) and flammable limits from 2.5 to 92 percent by volume in air. May ignite spontaneously in air when in contact with pourous materials, e.g., earth, asbestos, wood, or cloth or with metal oxides. Extinguish fire by flooding with water. For small fires use dry chemical,  $\text{CO}_2$ , or alcohol foam.

Toxicity: Methyl hydrazine is very toxic by inhalation of the vapors, by ingestion, and by absorption through the skin. As a systemic poison it attacks the liver and the red blood cells, causing oxygen starvation. In high concentrations it stimulates the central nervous system and can cause convulsions which in extreme cases are fatal.

Inhalation - Exposure to the airborne vapors should not exceed a suggested limit of 350 micrograms of vapor per cubic meter of air.

Skin and eye contact - Inflammation and swelling may occur following contact with the liquid or its vapors. Liquid is corrosive.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush immediately with plenty of water.

Skin - Flush immediately with large amounts of water and follow with a thorough washing with soap and water. Remove contaminated clothing at once.

Inhalation - Remove to fresh air. Administer artificial respiration if necessary.

Personnel Protection: Wear full protective clothing. If ventilation and containment does not maintain airborne vapors below safe levels, e.g., during clean-up of a spill, wear self-contained breathing apparatus.

Storage: Outside or detached storage is preferred. Inside storage should be in a flammable liquids cabinet. Separate MMH from oxidizing materials. Provide water for flushing spills or leaks.

Spill Control: Eliminate all sources of ignition and flammables. Deluge the spill areas with large quantities of water and flush, to dilute the mixture, to a catch basin. Neutralize with dilute sulfuric acid and flush to drain with plenty of water.

Disposal: Neutralize the solution with excess hydrogen peroxide (50-50).  
Dispose to the drain with excess water.

Chemical Incompatibility: Spontaneous ignition can occur with oxidants,  
e.g., hydrogen peroxide or nitric acid.

## METHYL ISOBUTYL KETONE

Chemical Formula:  $\text{CH}_3\text{CO}\cdot\text{CH}_2\text{CH}(\text{CH}_3)_2$

Synonyms: 2-pentanone, 4-methyl hexone; isopropyl acetone; 4 methyl 2-pentanone; MIK; MIBK; hexone; isobutyl methyl ketone

Description: A water-clear liquid with a sweet, pleasant odor detectable at less than 100 ppm.

Fire Hazard: MIK is considered a dangerous fire hazard when exposed to heat or flame. The flash point is 23° C (73° F), the explosive limits are 1.4 to 7.5 percent by volume in air. Extinguish fire with dry chemical, alcohol foam, or  $\text{CO}_2$ . Water may be ineffective.

Toxicity: MIK is moderately toxic by skin contact, inhalation, or ingestion. High doses can act as a narcotic and cause death.

Inhalation - Exposure to airborne vapors should not exceed a suggested limit of 100 parts per million parts of air (ppm) averaged over an eight hour work period. Concentrations less than 100 ppm can be detected by odor. The odor does not become objectionable to most people below 200 ppm; 400 ppm is irritating to the eyes, nose, and throat. Injuries and fatalities are reported for exposures to high concentrations.

Ingestion - Serious systemic poisoning can result from swallowing MIK. It is thought that less than 50 grams can be fatal.

Skin and Eye Contact - MIK is not absorbed into the body through intact skin. It acts as an irritant by defatting the skin. It is painfully irritating when splashed in the eye.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush the eyes with plenty of water.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage or emesis followed by catharsis.

\*Inhalation - Administer artificial respiration and oxygen as necessary.

Personnel Protection: Wear rubber gloves, chemical goggles, and face shield. When containment and ventilation are not sufficient to maintain vapor levels within safe concentrations, e.g., during a spill, wear self-contained breathing apparatus.

Storage: Store in a cool, dark, well-ventilated area. Isolate from other chemicals. Seal to avoid leakage.

Spill Control: Eliminate all sources of ignition and flammables. Absorb liquid on paper towels. Evaporate to dryness in a fume hood.

Chemical Incompatibility: MIK can ignite when in contact with potassium tert.-butoxide. Ketones in general form unsafe combinations with inorganic acids, caustics, amines, aldehydes, ammonia, and halogens.

## N-METHYL-P-TOLUENE SULFONATE

Chemical Formula:  $\text{CH}_3\text{C}_6\text{H}_4\text{SO}_3\text{CH}_3$

Description: White, damp crystals

Toxicity: Highly toxic by inhalation and highly irritating upon contact; a strong irritant to the eyes and skin. Skin contact can produce large painless blisters several hours after contact which result in pigmentation. Skin sensitization also occurs.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of water for at least 15 minutes

Skin - Wash thoroughly with soap and water

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If ventilation and containment cannot keep vapor levels within safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables.

Sweep onto paper and package in a cardboard container. Burn at an approved disposal area.

## NAPHTHALENE

Chemical Formula:  $C_{10}H_8$

Synonyms: naphthalin; tar camphor; moth flakes; white tar; naphthine

Description: White, crystalline, volatile flakes with a strong coal-tar or mothball odor. Odor can be detected at less than one part of vapor per million parts of air (ppm). Combustible, with a flash point of 80° C (174° F); explosive range is 0.9 to 5.9 percent in air.

Fire Hazard: When heated, this solid gives off flammable vapors which can form explosive mixtures with air. Flash point is 79° C (174° F). Extinguish fire with water, CO<sub>2</sub>, dry chemical, or foam.

Toxicity: Toxic by ingestion, inhalation, and possibly by absorption through the skin. Poisoning can cause anemia, kidney damage, eye injury and respiratory failure. It is irritating to any tissues contacted.

Inhalation - Exposure to airborne vapors should not exceed 10 ppm averaged over an eight-hour work period. High concentrations can cause eye opacities, anemia, and systemic poisoning.

Skin contact - Skin sensitization may result in severe dermatitis. Remove contaminated clothing and shoes.

Eye contact - Eye irritation, lens opacities, optical neuritis, conjunctivitis and corneal injury are all possible from eye contact.

Ingestion - The lethal dose is estimated to be from 5 to 15 grams.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid action.

Eyes - Flush with running water for at least 15 minutes; refer to ophthalmologist.

Skin contact - Flush with copious amounts of cold water and wash with soap and water.

\*Ingestion - Administer gastric lavage with large amounts of warm water. Follow by saline catharsis, e.g., 15-30 grams of sodium sulfate. Follow with demulcents, e.g., milk or egg white. Avoid oils.

\*General - Administer artificial respiration and oxygen, if necessary; follow kidney function and maintain alkaline urine. Force fluids. Transfuse blood if blood damage requires it. Further treatment is supportive and symptomatic.

**Personnel Protection:** Wear rubber gloves, chemical goggles, and if ventilation does not keep vapor concentration below safe levels, an appropriate chemical cartridge respirator. Launder contaminated clothing before re-using.

**Storage:** Store in a cool place away from sources of heat and oxidizing agents.

**Spill Control:** Eliminate all sources of ignition and flammables. Sweep onto paper and place in a cardboard container. Burn at an approved disposal site.

**Chemical Incompatibility:** The reaction with chromic anhydride can be violent. In general, aromatic hydrocarbons can form unsafe combinations with inorganic acids, halogens, and molten sulfur.



## NICKEL

Synonyms: Nickel sponge; Raney nickel

Description: Lustrous, hard, ductile, silvery metal

Toxicity: Nickel dust is recognized to produce cancer of the nasal sinuses and the respiratory system after prolonged, excessive exposure. Inhalation can also produce systemic poisoning affecting the respiratory system, the intestinal tract, the blood vessels, and result in decreased resistance to infection. Exposure to airborne concentrations of the dust should not exceed 1 milligram per cubic meter of air. Exposure to the skin can result in dermatitis or "nickel itch", with redness, blisters, and ulceration. The insoluble oxide and sulfide have also produced cancer in animal tests.

Inhalation - Exposure to airborne dust should not exceed one milligram per cubic meter of air averaged over an eight-hour work period.

Personnel Protection: Wear heavy gloves, safety glasses, and lab coat when working with dusts, powders, and fine cuttings. If local ventilation is not adequate to keep dust levels within safe levels, wear an approved mechanical filter respirator.

Disposal: Dispose of at an approved land-fill.

## NICKEL OXIDE

Chemical Formula: NiO

Synonyms: bunsenite; green nickel oxide; nickel monoxide; nickel protoxide

Description: A cubic, green-black crystal

Toxicity: Nickel oxide is recognized to produce cancer of the lungs and nasopharynx after prolonged, excessive exposure. It is toxic by inhalation and ingestion.

Inhalation - Exposure to airborne dust of nickel oxide should not exceed a recommended limit of 1.3 milligrams per cubic meter of air, averaged over an eight-hour work period. Overexposure can cause damage to lungs, pulmonary edema, and damage to kidney and blood vessels.

Ingestion - It is a slight toxic hazard when swallowed, generally acting as an emetic.

Skin and eye contact - Exposure to the skin can result in dermatitis or "Nickel itch" which is a result of skin sensitization. Contact with eyes is generally not a problem.

Treatment of Overexposure: Contact Medical Services

NOTE: Sections below marked (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with running water

Skin - Wash with soap and water

\*Inhalation - Administer oxygen if pulmonary edema is present.

\*Ingestion - Administer gastric lavage

\*Further treatment is symptomatic and supportive.

## NICKEL SULFATE

Chemical Formula:  $\text{NiSO}_4$

Synonyms: Nickelous sulfate

Description: Cubic yellow or pale green crystals; odorless

Toxicity: Nickel compounds are considered slightly toxic but not generally a systemic poison.

Inhalation - A low level of toxicity is presented by inhalation.

Exposure to airborne dusts should not exceed 1 milligram of  $\text{NiSO}_4$  per cubic meter of air averaged over an eight-hour work period.

Ingestion - Swallowing a toxic quantity or prolonged ingestion can result in damage to the liver and heart. Nickel salts act as an emetic.

Skin - Skin contact can cause eczema, dermatitis, and allergic reactions (nickel itch).

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water for 15 minutes

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

Inhalation or ingestion - Medical treatment that is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat.

Spill Control: Cover solutions with soda ash, mix and scoop into a beaker of water. Neutralize with 6M-HCl and wash down drain with excess water. Collect solid spills in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and treat as above.

## NITRIC ACID

Chemical Formula:  $\text{HNO}_3$

Synonyms: aqua fortis; hydrogen nitrate; azotic acid; engraver's acid

Description: A clear, colorless to light brown, fuming, suffocating liquid with acrid odor; turns yellow to yellow-brown upon exposure to light.

Fire Hazard: Non-combustible, but dangerously reactive with many materials, and can cause fires. Fight fires with water.

Toxicity: A high health hazard through exposure by contact, ingestion or inhalation. Extremely irritating and caustic as a liquid, vapor, or fume upon any tissue contacted.

Inhalation - Extremely irritating to the nose, throat, and lungs when the vapors are inhaled. Exposure to airborne vapors should not exceed two parts per million parts of air averaged over an eight-hour work period.

Ingestion - Tissue destruction, pain, and gastrointestinal distress leading to perforation of the stomach can result.

Skin and Eye Contact - Dangerous to the eyes. Skin irritation and ulceration can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes.

Get medical attention.

Skin - Wash with soap and water or with a 5 percent solution of sodium bicarbonate. Remove contaminated clothing and shoes.

\*Treat burns with wet dressings of saturated solution of sodium thiosulfate.

\*Ingestion - Avoid lavage or emetics. Administer, by mouth, diluents such as water and neutralizer such as calcium hydroxide or aluminum hydroxide. As necessary, treat for shock, and administer oxygen and morphine. Other treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. Handle in well-ventilated area. If vapors may exceed safe concentrations, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Cover contaminated surface with sodium bicarbonate or a soda ash-slaked lime mixture (50-50). Mix and add water if necessary to form a slurry. Scoop up the slurry and wash down the drain with excess water. Wash spill site with soda ash solution.

Chemical Incompatibility: Very powerful oxidizing agent. Never use to clean out alcoholic or other organic wastes. Keep separate from metallic powders, carbides, hydrogen sulfide, and turpentine. Forms dangerous combinations with acetic acid, acetic anhydride, acrolein, ammonia, caustics, aniline, arsine, cresol, cyanides, ketones, chromic acid, halogens, hydrazine, hydrogen peroxide, hydrocyanic acid, ketones, nitrobenzene, oleum, phosphine, stibine, terpenes, thiocyanates, toluene, vinyl acetate, and vinylidene chloride, among many others.

## NITRIC OXIDE

Chemical Formula: NO

Synonyms: mononitrogen monoxide; nitrogen monoxide

Description: A colorless gas which in air quickly oxidizes to NO<sub>2</sub>, a reddish-brown gas. Noncombustible, but supports combustion.

Toxicity: A highly toxic inhalation hazard. It forms acid when it contacts the moisture deep in the lungs. High concentrations are irritating but lower, still hazardous concentrations do not give initial discomfort. When heated to decomposition it emits highly toxic fumes.

Exposure should not exceed 25 parts per million parts of air (ppm) averaged over an eight-hour work period. 60-100 ppm causes irritation of nose and throat; 100-150 ppm is dangerous for short exposures; 200-700 ppm is fatal after very short exposure, producing lung damage, central nervous system depression, paralysis, convulsions, and death. Prolonged exposure to lower concentrations produces lung damage and corrosion of the teeth.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: This information is primarily for the attention of medical personnel and is not to be considered as first aid action.

Immediately after exposure, remove to fresh air, breathe as hard and fast as possible to clear the lungs. Close observation and bed rest is required for 24-48 hours. Keep the victim warm; oxygen therapy is advisable; administer sedation to diminish anxiety. Further detailed treatment is well detailed in the literature.

Personnel Protection: Work should be done within a fume hood or in an open area out-of-doors when practical. Otherwise maintain the concentration in the work area to levels below the threshold limit by ventilation and enclosure.

Leak Control: Wear self-contained breathing apparatus; long rubber gloves, and lab coat. Allow the leaking gas to flow into a mixed solution of caustic soda and slaked lime. Place container in fume hood.

Chemical Incompatibility: Forms dangerous combinations with aluminum, boron, carbon disulfide, chlorine monoxide, chromium, fluorine, fuels, nitrogen trichloride, ozone, phosphine, phosphorus, rubidium carbide, sodium monoxide, UDMH, and uranium.

## NITROBENZENE

Chemical Formula:  $C_6H_5NO_2$

Synonyms: nitrobenzol; oil of mirbane; essence of mirbane; mirbane oil; nigrosine spirit soluble B; essence of myrbane; C.I. Solvent Black 5

Description: Almost water white turning to yellow or greenish-yellow crystals or yellow to brown, oily liquid. Has an almond odor.

Fire Hazard: Combustible; flash point is 88° C (190° F) explosive limits range from 1.8 percent. Emits toxic gases when heated. Extinguish fires with water spray, dry chemical, foam, or CO<sub>2</sub>.

Toxicity: Highly toxic; fatal amounts may be absorbed through the skin, by inhalation, or ingestion. It depresses the central nervous system and heart muscle; it causes cyanosis due to formation of methemoglobin in the blood; it affects the function of the spleen, liver, and kidneys.

Inhalation - Exposure to airborne vapors should not exceed one part of vapor per million parts of air (ppm) averaged over an eight-hour work period. Inhalation of high concentrations may prove rapidly fatal.

Ingestion - Poison symptoms by ingestion may be delayed several hours. One to five grams is capable of producing death.

Skin contact - A large area of the body in contact with the liquid can be fatal almost immediately.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Immediately flush with large amounts of water.

Skin - Immediately remove contaminated clothing, flush skin with large quantities of water, and wash with soap and water. Include hair, under nails, and ear canals. Rinse well.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Keep warm and in rest. Administer no acetanilide or alcohol. Follow methemoglobinemia condition and administer blood transfusions if necessary. Additional treatment is supportive and symptomatic, particularly for central nervous system collapse and shock.

Personnel Protection: Processes should be enclosed where possible, e.g., fume hood, and compressed air or vacuum used for filling or emptying receptacles. Where concentration of vapors cannot be kept below safe levels, e.g., during clean-up of a spill, wear self-contained breathing apparatus. Wear butyl rubber gloves, lab coat, and chemical goggles.



Spill Control: Absorb liquid spills with paper towels or vermiculite. Allow to evaporate to dryness in a fume hood. Sweep solids into cardboard container and burn at an approved disposal site. Wash the spill site thoroughly with strong soap solution.

Chemical Incompatibility: Can form dangerous combinations with aluminum chloride and phenol, with aniline and glycerine, with nitric acid, nitrogen tetroxide, or silver perchlorate.

## NITROGEN DIOXIDE

Chemical Formula:  $\text{NO}_2$ ;  $\text{N}_2\text{O}_4$

Synonyms: nitrogen peroxide; nitrogen tetroxide; nitrito

Description: A dark red-brown gas ( $\text{NO}_2$ ). A yellow or colorless solid ( $\text{N}_2\text{O}_4$ )

Fire Hazard: Noncombustible, but strong oxidizing agent. May cause fire in contact with clothing or other combustibles.

Toxicity: A highly toxic inhalation hazard. They form acids when in contact with the moisture deep in the lungs. High concentrations are irritating but lower still hazardous concentrations do not give initial discomfort. On toxic overexposure there may be no discomfort until 5 to 72 hours later. Lethal quantities can be inhaled without serious discomfort.

Exposure should not exceed 5 parts gas per million parts of air (ppm) averaged over an eight-hour work period. 10-20 ppm is irritating to the eyes; 100 ppm is visible in air; 100 ppm for 30 minutes can be dangerous; 200-700 ppm can be rapidly fatal after short exposure. Lung damage can result in air hunger, cyanosis, loss of consciousness, and death due to pulmonary failure. Recovery period may be accompanied by pneumonia, and emphysema. Eye injury includes edema of eyelids and ulceration of cornea. Prolonged exposure to low concentrations may produce chronic cough, lung irritation, corrosion of the teeth, and ulceration of mouth and nose.

Treatment of Overexposure: Contact Medical Services immediately. This information is primarily for the attention of medical personnel and is not to be considered action for first aid.

Immediately after exposure and removal to fresh air, breathe as hard and fast as possible to clear the lungs. Complete bed rest for 24-48 hours with close hourly observation of vital signs. Keep the victim warm; oxygen therapy; sedation to diminish anxiety. Further detailed treatment is well covered in the literature.

Personnel Protection: Maintain gas concentrations below safe levels by ventilation and containment. If work must be done in high concentrations, e.g., handling a leaking container, wear chemical goggles, self-contained breathing apparatus, rubber gloves, and lab coat.

Leak Control: Allow the leak to flow into a mixed solution of caustic soda and slaked lime. If possible keep in a fume hood until cylinder is emptied.

Chemical Incompatibility: Can form dangerous combinations with cyclohexane, fluorine, and formaldehyde.

## NITROMETHANE

Chemical Formula:  $\text{CH}_3\text{NO}_2$

Synonym: nitrocarbol

Description: A colorless, transparent, oily liquid with a moderately strong, disagreeable odor detectable at 100 ppm.

Fire Hazard: A dangerous fire and explosion hazard with a flash point of  $35^\circ\text{C}$  ( $95^\circ\text{F}$ ) and autoignition temperature of  $418^\circ\text{C}$  ( $785^\circ\text{F}$ ). The lower explosive limit is 7.3 percent in air. Extinguish fire with water, foam, dry chemical, or  $\text{CO}_2$ . Cool heat-exposed containers with water, and continue to cool after fire is extinguished. Fight fire from a distance.

Toxicity: Nitromethane is moderately to highly toxic by inhalation, ingestion, and skin contact. Products of decomposition are also toxic.

Inhalation - Exposure to the vapors should not exceed 100 parts per million parts of air (ppm) averaged over an eight-hour work period. It is irritating to the nose and throat at 200 ppm. Higher concentrations can lead to narcosis and death.

Ingestion - Systemic poisoning produces nervous system upset and damage to the liver and kidneys.

Skin and eye contact - It is mildly irritating to the skin and eyes. It is not absorbed into the body through the skin. There is generally no allergic response.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush eyes with plenty of water

Skin - Wash with soap and water. Remove contaminated clothing immediately. Do not wear until laundered.

\*Ingestion - Induce vomiting and follow with gastric lavage.

\*General - Administer artificial respiration and oxygen if necessary. Further treatment is supportive and symptomatic.

Personnel Protection: Wear neoprene gloves, lab coat, and chemical goggles. Provide good ventilation or maintain vapor level below safe limits by containment. If vapors cannot be maintained below these levels, e.g., during clean-up of a spill, wear self-contained breathing apparatus. Respirators containing activated charcoal or Hopcalite catalyze should not be used.

Storage: Store in an isolated outdoor storage facility.

Spill Control: Eliminate all sources of ignition. Cover spill with soda ash. Mix and spray with water. Scoop into a bucket of water. Let stand for two hours. Neutralize with 6M-HCl and a large excess of water. Wash spill site with soap solution.

Chemical Incompatibility: Aniline, ethylene diamine, and similar alkaline materials increase the explosion hazard to shock potential. Amines plus heavy metal oxides form fulminates. Dry or highly concentrated alkalies form salts which decompose explosively if heated or subjected to shock in the dry state. Nitrolic acids are formed when nitromethane reacts with nitrous acid; its salts are explosive when dry. Nitromethane also forms unsafe combinations with calcium hydroxide, calcium hypochlorite, hexamethylbenzene, hydrocarbons, and organic amines.

### 3-NITROSTYRENE

Synonyms: nitrophenylethylene; B.N.S.; nitrostyrolene

Description: A colorless liquid

Fire Hazard: A moderate fire and explosion hazard by spontaneous chemical reaction. Toxic fumes are emitted when heated to decomposition.

Toxicity: Nitrostyrene is moderately toxic by ingestion and inhalation. Large amounts, when ingested, can produce serious and even fatal results. It also acts as an irritant to the skin and eyes.

Nitrostyrene has been implicated in increased cancer incidence.

Personnel Protection: Wear rubber gloves, face shield or chemical goggles, and lab coat.

Spill Control: Eliminate all sources of ignition and flammables. Absorb on paper towels and evaporate to dryness in a fume hood.

## OCTADECYLAMINE

Chemical Formula:  $\text{CH}_3(\text{CH}_2)_{17}\text{NH}_2$

Description: liquid; insoluble in water

Toxicity: Local irritant for eyes, skin, and mucous membrane. Repeated exposure may produce sensitivity reaction.

Ingestion by animals results in weight loss and damage to the liver and gastrointestinal tract.

Inhalation produces degeneration of the central nervous system in animals at a concentration of 0.005 mg of vapor per liter of air.

Treatment of Overexposure: Contact Medical Services immediately. Not much is known about the toxicity of octadecylamine except in laboratory animals.

Eyes - Flush with water

Skin - Wash with soap and water

Inhalation or ingestion - Treatment is symptomatic and supportive.

Personnel Protection: Wear butyl rubber gloves, face shield, and lab coat.

Spill Control: Cover spill with sodium bisulfate. Spray with water and wash into the drain with a large excess of water.

Chemical Incompatibility: Amines in general form unsafe combinations with inorganic acids, organic acids, halogenated compounds, aldehydes, ketones, esters, phenols, cyanohydrins, nitriles, and acid anhydrides.



## OXALATE SALTS

Chemical Formula:  $\text{-C}_2\text{O}_4^{-2}$

Description: Generally white, or transparent, crystals

Toxicity: The oxalate salts, e.g., sodium or potassium oxalate, present a high toxic hazard since they are severe corrosives. In addition, as systemic poisons they can damage the kidneys severely and, by removing body fluid calcium, cause cardiac failure. They also deprive the body of haemoglobin necessary for oxygen use.

Skin and eye contact - The oxalates are irritating to the eyes and skin on contact.

Ingestion - Swallowing less than one ounce can be lethal. The corrosive action can cause death by gastroenteritis and shock.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with running water

Skin - Wash with soap and water

\*Ingestion - Immediately administer gastric lavage using a dilute solution of any soluble calcium, e.g., lime water, or even milk. Gastric lavage is contraindicated if severe injury of mucosa is evident. Administer 10-20 ml. of 10 percent calcium glutamate slowly by I.V. - may have to repeat frequently.

\*Administer morphine for pain, if necessary. (Additional specific treatment is available in the literature.)

Personnel Protection: Wear rubber gloves, lab coat, and chemical goggles. If dust could become airborne, e.g., during clean-up of a spill, wear the appropriate mechanical filter respirator.

Disposal: React the material with excess  $\text{KMnO}_4$  in hot aqueous solution ( $>60^\circ \text{C}$ ) in an acid solution, e.g., dilute  $\text{H}_2\text{SO}_4$ . Or add soluble calcium salt, e.g.,  $\text{CaCl}_2$  solution to the oxalate solution. The precipitate may be safely washed away.

## OXALIC ACID CRYSTALS

Chemical Formula:  $\text{HOOC}\cdot\text{COOH}\cdot 2\text{H}_2\text{O}$

Synonym: ethanedioic acid

Description: Transparent colorless crystals; odorless

Fire Hazard: Combustible below  $102^\circ\text{C}$  ( $215^\circ\text{F}$ ). With heat decomposes with emission of carbon monoxide and formic acid. Extinguish fires with water spray, dry chemical, alcohol foam, or  $\text{CO}_2$ .

Toxicity: Highly toxic by inhalation, skin absorption, and ingestion. As a systemic poison it depresses the central nervous system, disturbs heart action, and causes injuries to the kidneys. As a severe corrosive agent it is strongly irritating to tissues it contacts. Ingestion can result in death due to tissue damage and shock.

Inhalation - Exposure to airborne dust or vapors should not exceed one milligram per cubic meter of air averaged over an eight-hour work period; highly irritating to the upper respiratory tract and capable of producing ulceration of the nose and throat.

Ingestion - The average lethal dose is estimated to be from 15 to 30 grams. Systemic poisoning may exhibit itself in a bluish hue to the skin and yellow, brittle nails.

Skin and eye contact - Overexposure can cause gangrenous ulceration of the skin; eye contact can cause corneal damage and conjunctivitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not first aid actions.

Eyes - Immediately flush with plenty of water

Skin - Immediately wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer, by mouth, a dilute solution of any soluble calcium salt, e.g., lime water or milk; followed by gastric lavage with lime water if no mucosal damage is evident. Follow with milk of magnesium. Further detailed treatment is set forth in the open literature. Do not induce vomiting.

Personnel Protection: Wear rubber gloves, chemical goggles and lab coat. If ventilation can not maintain dust concentrations below safe levels, e.g., in cleaning up a spill, wear the appropriate chemical cartridge respirator.

Spill Control: Cover the spill with soda ash or sodium bicarbonate. Mix and add water if necessary. Scoop up the slurry and neutralize in a beaker with 6M  $\text{NH}_4\text{OH}$  or 6M  $\text{HCl}$  as required. Wash this waste down the drain with an excess of water. Wash the spill site with soda ash solution.

Disposal: May be dissolved in a flammable solvent and burned at an approved disposal site.

Chemical Incompatibility: Oxalic acid can form dangerous combinations with furfuryl alcohol, silver, sodium, mercury, chlorite, and sodium hypochlorite. Reacts explosively with strong oxidizing materials.

## OZONE

Chemical Formula:  $O_3$

Synonyms: triatomic oxygen

Description: Colorless to bluish gas with a sulfur-like pungent smell detectable at 0.1 ppm.

Fire Hazard: Dangerous, by chemical reaction with reducing agents or combustibles. Concentrations greater than 25 percent can cause explosive combustion.

Toxicity: The most important effect is by inhalation, with a strong irritation of the upper respiratory tract, mucous membrane, and deep lung injury. Ozone to be effective as a bactericide or deodorizer must be present in concentrations far greater than can be safely tolerated by man. Ozone in excess can produce damage to chromosome structures in cells. Exposure should not exceed 0.1 parts per million parts of air (ppm) averaged over an eight-hour work period. One ppm produces cough and serious fatigue; 5-10 ppm produces general body pain, stupefaction and accelerated pulse; 50 ppm for 30 minutes has produced fatal results due to lung damage. Ozone does not have the life-sustaining properties of oxygen.

Treatment of Overexposure: Contact Medical Services immediately. Administer oxygen and artificial respiration if necessary. Observe for symptoms of lung edema.

Personnel Protection: Where release of ozone to the work environment may exceed safe limits, e.g., a leaking container, evacuate the area and wear a self-contained breathing apparatus to handle the container. Place the leaking container in a fume hood or in an open area until the container is empty.

Chemical Incompatibility: Ozone forms dangerous combinations with aniline, benzene, bromine, diethyl ether, dinitrogen pentoxide, ethylene, hydrogen bromide, hydrogen iodide, nitric oxide, nitrogen dioxide, nitrogen trichloride, nitrogen triiodide, nitroglycerin, stibine, and organic matter.

## PERCHLORIC ACID

Chemical Formula:  $\text{HClO}_4$

Synonyms: perchloric acid dihydrate; Fraude's Reagent; dioxonium perchlorate; hydronium perchlorate

Description: A clear, colorless, odorless, fuming, unstable liquid

Fire Hazard: A moderate fire hazard. When heated, shocked, or exposed to certain chemicals can emit highly toxic fumes of chlorides. Extinguish fires with water spray. If organic materials are present an explosion may occur.

Toxicity: A high health hazard by ingestion, inhalation, and by contact. Acts as an irritant and, in some instances, as a sensitizer.

Inhalation - Perchloric acid is highly irritating to the lungs and respiratory tract when the vapors are inhaled.

Ingestion - Burns to the upper gastrointestinal tract can occur. As little as one milliliter has been fatal.

Skin and eyes - Contact with the eyes can result in corneal damage; contact with the skin can result in corrosive burns from as little as four milliliters of liquid.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel, and are included here for information only, not for first aid.

Eyes - Flush with water for at least fifteen minutes before seeking medical aid

Skin - Wash with soap and water

\*Treat skin burns as for any other burn

\*Ingestion - Administer gastric lavage with 5 percent solution of sodium bicarbonate followed by instillation of aluminum hydroxide gel. Caution: gases will be generated.

\*General - Administer oxygen for respiratory difficulties as indicated. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. If containment and ventilation does not keep vapor concentrations in the work area below safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Storage: Use a reagent bottle in a maximum 1-lb glass-stoppered glass bottle kept in a heavy glass tray of larger capacity. Store separated from combustible materials, organic materials, strong dehydrating agents, and oxidizing and reducing agents. Do not permit to freeze ( $-20^{\circ}\text{C}$ ). In anhydrous form it can decompose explosively and spontaneously.

**Spill Control:** Cover the spill with a reducer (hypo, a bisulfite, or a ferrous salt), but not carbon, sulfur, or strong reducing agents. Mix well and spray with water. A sulfite or a ferrous salt will require addition of some 3M-H<sub>2</sub>SO<sub>4</sub> to promote rapid reduction. Scoop the slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash the spill site with a soap solution containing some reducer.

**Disposal:** Dispose of unwanted supplies by mixing with at least ten times its volume of water in a glass or porcelain vessel, neutralize with Na<sub>2</sub>CO<sub>3</sub> and flush down an outside drain or at an approved disposal pit with additional water.

**Chemical Incompatibility:** Strong dehydrating agents may convert the solution to anhydrous acid which decomposes at ordinary temperatures and explodes on contact with most organic materials. It can form dangerous combinations with acetic acid, acetic anhydride, alcohols, antimony compounds, bismuth, organic materials, dibutyl sulfoxide, diethyl ether, fluorine, glycols, ketones, hydronic acid, hydrogen, HCl, hypophosphites, nitrosophenol, sodium iodide, sulfoxides, and sulfur trioxide.

## PHENANTHRENE

Chemical Formula:  $(C_6H_4CH)_2$

Description: Colorless, solid or monoclinic, shining crystals. Combustible.

Toxicity: As a poison, phenanthrene has a low hazard rating for skin and eye contact, irritation, and for absorption by ingestion, inhalation, and skin penetration. Allergic reactions can occur including sensitization of the skin to light. The main concern is that it is considered to be a cancer producer. There were no details regarding its carcinogenic action in the literature; however, in pure form it does not appear to be carcinogenic.

Fire Hazard: Slight hazard when exposed to heat or flame. Extinguish fires with water, foam,  $CO_2$  or dry chemical.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. Work within fume hood.

Spill Control: Eliminate all sources of ignition. Sweep onto paper and place in a cardboard container. Burn at an approved disposal site.

Disposal: Package in flammable container and burn at an approved disposal site.



## PHENOL

Chemical Formula:  $C_6H_5OH$

Synonyms: carbolic acid; phenylic acid; phenic acid; phenyl hydroxide; benzophenol; hydroxybenzene

Description: White, needle-shaped, translucent crystals which turn pink or red if not pure; has a burning taste and distinctive sweet, tarry odor detectable at less than 1 ppm.

Fire Hazard: Phenol is a moderate fire hazard when exposed to heat; flash point is  $80^{\circ}C$  ( $175^{\circ}F$ ). Extinguish fire with water spray, dry chemical, foam, or  $CO_2$ . Poisonous flammable gases are produced in a fire.

Toxicity: It has a high toxic hazard by inhalation, ingestion, or skin contact. It is a general poison, toxic to all cells. It depresses the central nervous system, damages the kidney, liver, lungs, spleen and pancreas. It has caused cancer in some test animals.

Ingestion - May result in corrosion of the mouth, throat, and stomach including perforation. Even one gram ingested has been reported to result in death.

Skin and eye contact - It can be absorbed through the intact skin in lethal amounts very rapidly. Concentrated solutions (greater than 10 percent) are highly corrosive with formation of gangrene due to blood vessel damage. Numbness, followed by intense pain, can occur.

Inhalation - Exposure to airborne concentrations should not exceed 5 parts per million parts of air (ppm) averaged over an eight-hour work period. 30 to 60 ppm can result in respiratory difficulty and lung damage.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Wash with water for at least 15 minutes. See an ophthalmologist to prevent injury.

Skin - Immediately wash with soap and water for 15 minutes and then apply and wipe off olive oil or alcohol. Remove contaminated clothing and shoes.

\*Treat skin burns in the same manner as thermal burns.

\*Ingestion - Administer gastric lavage with olive oil or other vegetable oil. Avoid mineral oil or alcohol. Follow with saline catharsis and demulcents. Do not induce vomiting. Administer emetics.

\*General - Administer morphine for pain. Administer oxygen and artificial respiration as necessary. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield or chemical goggles and lab coat. Wear self-contained breathing apparatus if vapors may exceed safe levels, e.g., during clean-up of a spill.

Storage: Store in a cool, dry, well-ventilated location.

Spill Control: Eliminate all sources of ignition and flammables. Sweep onto paper and place in cardboard container. Burn at an approved disposal site.

Chemical Incompatibility: Reacts dangerously with aluminum chloride plus nitrobenzene, with butadiene and with calcium hypochlorite. Phenols in general also can form unsafe combinations with caustics, amines, aldehydes, esters, alkylene oxides, ammonia, halogens, ethers, and acid anhydrides.

## PHENYL BENZOATE

Chemical Formula:  $C_6H_5COOC_6H_5$

Synonyms: benzophenid; phenol benzoate; benzocarbolic acid

Description: Colorless crystals with a geranium odor

Toxicity: The open literature contained no information on the toxicity of phenyl benzoate except that it is similar to that of phenol. Phenol presents a high health hazard through exposure by contact, ingestion, and inhalation.

See the Toxic Substances Alert "Phenol" for further information.

## M-PHENYLENEDIAMINE

Chemical Formula:  $C_6H_4(NH_2)_2$

Synonyms: meta-diaminobenzene; 3-aminoaniline; 1,3-benzenediamine; diaminobenzene

Description: Colorless or white crystals which darken if exposed to light.

Toxicity: meta-phenylenediamine is irritating on contact with the skin, eyes, or mucous membrane. It has been known to sensitize the worker to skin dermatitis or asthma-like reactions upon repeated exposures. It is highly toxic if swallowed, resulting in severe liver damage.

The ortho- and para-isomers are highly toxic and are suspected bladder carcinogens. They are also potent sensitizers.

Inhalation - Exposure to the airborne dust should not exceed 0.1 milligrams per cubic meter of air, averaged over an eight-hour work period.

Treatment of Overexposure: Contact Medical Services. Flush eyes promptly with water and wash the skin with soap and water if contact with the eyes or skin occurs. Remove contaminated clothing and shoes. Further treatment is supportive and symptomatic.

Personnel Protection: Wear butyl rubber gloves, chemical goggles, and lab coat when handling. If there is a possibility of airborne dust, e.g., when cleaning up a spill, wear an approved chemical cartridge respirator or self-contained breathing apparatus.

Spill Control: Brush spilled material into cardboard container and burn at an approved disposal site. Absorb spilled solutions with paper towels and evaporate to dryness in a fume hood. Burn the paper. Wash the spill site with strong soap solution.

## PHOSPHIDE COMPOUNDS

**Toxicity:** Phosphides may present a dangerous toxicity hazard because when heated to decomposition or in the presence of water they emit phosphine gas ( $\text{PH}_3$ ). Phosphine is a high inhalation hazard. The metal portion of the phosphide compound may also present toxic hazards.

**Fire Hazard:** The decomposition products generated when phosphides are heated or reacted with water can be spontaneously flammable.

**Personnel Protection:** Wear rubber gloves, safety glasses, and lab coat.

**Spill Control and Disposal:** Collect in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and neutralize with 6M-HCl. Wash down the drain with excess water.

## PHOSPHINE

Chemical Formula:  $\text{PH}_3$

Synonyms: hydrogen phosphide; phosphoretted hydrogen

Description: colorless, irritating gas with garlic, mustard or rotten fish odor detectable at less than 1 ppm.

Fire Hazard: Burns spontaneously at low temperature  $40^\circ \text{C}$  ( $104^\circ \text{F}$ ). When heated to decomposition, emits highly toxic fumes. Extinguish fire with  $\text{CO}_2$ , dry chemical, or water spray. May be spontaneously flammable due to impurities.

Toxicity: A very toxic gas which causes depression of the central nervous system and lung irritation. Exposure should not exceed 0.3 parts per million parts of air averaged over an eight-hour work day. Chronic poisoning results in bronchitis, anemia, stomach-intestinal upset and disturbance of coordination. High concentrations can lead to convulsions, coma, and death. 1000 ppm for 10 minutes may be fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Actions marked with (\*) are for the attention of medical personnel and are not first aid actions.

\*Administer artificial respiration and oxygen, if necessary. Enforce bed rest.

\*Administer bronchodilators and decongestants; codein for cough.

\*Subsequent treatment is symptomatic and supportive.

Leak Control: Eliminate all sources of ignition. Place in a fume hood to safely ventilate the gas. Wear a self-contained breathing apparatus when handling the leaking container.

Storage: Strictly avoid moist air. Store in a cool, well-ventilated area.

Chemical Incompatibility: Reacts violently with oxygen and halogens.

## PHOSPHORIC ACID

Chemical Formula:  $\text{H}_3\text{PO}_4$

Description: A colorless, syrupy liquid or clear rhombic crystals; odorless

Synonyms: orthophosphoric acid

Fire Hazard: Dangerous; when heated to decomposition it emits toxic fumes of oxides of phosphorous. Not flammable but contact with common metals can produce explosive hydrogen.

Toxicity: Phosphoric acid is a moderate hazard as a contact irritant, when ingested, or when inhaled.

Inhalation - Exposure to airborne vapors should not exceed 1 milligram per cubic meter of air averaged over an eight-hour work period. Toxic, irritant effects are seen at this level after prolonged exposures.

Skin and eye contact - Phosphoric acid is corrosive to the skin and eyes on contact at 75 percent concentration or greater. It will destroy tissue and produce severe burns.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with slowly running water for 10 to 15 minutes. Report to Medical Services.

Skin - Irrigate with water and then wash with soap and water. Remove contaminated clothing and shoes.

\*Treat skin burns as usual.

\*Inhalation - Administer 100 percent oxygen with positive pressure for 1/2 hour of every hour for 3 to 6 hours.

\*Ingestion - Avoid gastric lavage or emetics. Administer neutralizer and diluent such as milk of magnesium or calcium hydroxide; drink plenty of water; administer emulcents, e.g., olive oil, milk, or egg whites. Do not induce vomiting. Wash mouth out thoroughly with water or sodium bicarbonate solution.

Personnel Protection: Prevent direct contact by wearing rubber gloves, chemical goggles, and lab coat. Eye wash and safety showers should be located nearby. If dust or vapors could become airborne in excess of safe levels, e.g., during clean-up of spill, wear approved acid gas chemical cartridge respirator, or self-contained breathing apparatus.



Spill Control and Disposal: Cover the spill with sodium bicarbonate or a soda ash-slaked lime mixture (50-50). Mix and add water if necessary to form a slurry. Scoop up slurry and wash down the drain with excess water. Wash the spill site with soda ash solution.

Chemical Incompatibility: Inorganic acids in general can form unsafe combinations with organic acids, caustics, amines, halogenated compounds, alcohols, glycols, aldehydes, ketones, aromatic hydrocarbons, olefins, esters, ethylene oxides, cyanohydrins, nitriles, ammonia, ethers, and acid anhydrides.

## PHOSPHOROUS TRIBROMIDE; PHOSPHOROUS TRICHLORIDE

Chemical Formulae:  $\text{PBr}_3$ ;  $\text{PCl}_3$

Description: Clear fuming colorless liquids with sharp penetrating odors

Fire Hazard: Non-flammable, but will react violently when brought into contact with water. Use  $\text{CO}_2$  or dry chemical to fight fires involving this material.

Toxicity: Both chemicals are highly toxic due to their strong irritant and corrosive actions with tissue on contact. They are toxic by ingestion, inhalation, and by contact.

Inhalation - These materials form hydrochloric acid and hydrobromic acid when in contact with moisture, e.g., by lung inhalation. Exposure to vapors should not exceed 0.5 parts per million parts of air averaged over an eight-hour work period. Overexposures can result in bronchitis, pulmonary edema, and bronchopneumonia.

Ingestion - Contact with the mucous membranes can cause serious acid burns. One gram is considered a fatal dose.

Skin and eye contact - Strong irritation and acid burn can result in complete tissue destruction.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not intended as first aid actions.

Eyes - Immediately flush with plenty of water. \*Obtain services of ophthalmologist.

\*Skin - Wash with 5 percent solution of copper sulfate followed by wash with soap and water and the usual burn therapy.

\*Inhalation - Administer intermittent positive pressure oxygen therapy.

\*Ingestion - Avoid lavage or emetics. Administer, by mouth, diluents such as water and neutralizers such as milk of magnesium, followed by demulcents such as milk. Do not induce vomiting. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear long rubber gloves, chemical goggles, and and lab coat. Where possible, work in a fume hood from behind a body shield or in an open area out-of-doors. Where vapors could exceed safe limits, e.g., during clean-up of spills, wear a self-contained breathing apparatus.

Storage: Store in a cool dry place. Storage containers should be corrosion-resistant, e.g., glass, ceramics, enamel lining, nickel, or lead.

Spill Control: Eliminate all sources of ignition. Cover with dry vermiculite, sodium bicarbonate or a mixture of soda ash and slaked lime (50-50). Mix and spray water cautiously from an atomizer. Beware of flash fire. Scoop up and add slowly to a large container of water (if too reactive continue spraying). When the reaction is complete, neutralize (litmus test) with 6M-NH<sub>4</sub>OH or 6M-HCl as required. Wash down the drain with a large excess of water. Wash the spill site with soap solution.

Disposal: Break the container in an approved outside disposal area and wash away at a safe distance with an excess of water.

Chemical Incompatibility: These materials form unsafe combinations with the following:

PBr<sub>3</sub> - potassium, ruthenium tetroxide, sodium or water.

PCl<sub>3</sub> - acetic acid, aluminum, chromyl chloride, dimethyl sulfoxide, fluorine, hydroxyamine, iodine monochloride, lead dioxide, nitric acid, nitrous acid, organic matter, potassium, sodium, or water.

## PHOSPHORYL CHLORIDE

Chemical Formula:  $\text{POCl}_3$

Synonym: phosphorous oxychloride

Description: A colorless to slightly yellow strongly fuming liquid with a pungent odor.

Fire Hazard: Noncombustible. It emits highly toxic fumes of chlorides and oxides of phosphorous when heated to decomposition. Do not use water to fight fire. It reacts violently to give off hydrogen chloride.

Toxicity: Phosphoryl chloride is highly toxic by ingestion, inhalation of the vapors, or by contact. It is a strong irritant and corrosive to tissues it contacts.

Inhalation - Exposure to the airborne vapors should not exceed a suggested limit of 0.5 parts of vapor per million parts of air averaged over an eight-hour work period. Corrosive destruction of mucous membrane and lung tissue occurs at high concentrations.

Ingestion - Tissue destruction, gastrointestinal distress, and pain can lead to death from circulatory shock, asphyxia due to swelling, perforation of the stomach, or infection. One gram is estimated to be a fatal dose.

Skin and eye contact - It is a strong irritant to any tissue contacted due to corrosive effects.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes. Get medical attention.

Skin - Wash with plenty of water for 15 minutes. If clothing becomes contaminated flush thoroughly with water before removing.

\*Ingestion - Avoid lavage or emetics. Administer by mouth diluants such as water and neutralizer such as milk of magnesium in large quantities, followed by demulcents such as milk or olive oil.

\*General - Opiates to relieve pain. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. When containment and ventilation do not keep vapor concentrations below safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

**Storage:** Store in a dry, well-ventilated area above its freezing point of 1° C (34° F). Do not store with combustible materials, particularly fibrous organic materials, or with electronic or other equipment which can be corroded.

**Spill Control:** Cover spill with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water.

**Chemical Incompatibility:** Halogenated compounds in general form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## PIPERIDINE

Chemical Formula:  $(CH_2)_5NH$

Synonyms: azacyclohexane; cyclopentimine; cypentil; pentamethyleneimine; hexahydropyridine

Description: A clear, colorless liquid with an amine-like or pepper-like odor.

Fire Hazard: Flammable, with a flash point of 16° C (61° F). When heated to decomposition it emits highly toxic fumes of nitrogen oxides. Extinguish fire with an alcohol foam. Water may be ineffective.

Toxicity: Piperidine is a high skin irritation and eye contact hazard. It is moderately toxic by inhalation, skin absorption, and by ingestion.

Ingestion - One gram is considered to be a lethal dose. It strongly depresses the central nervous system and causes ataxia, convulsions, and respiratory distress.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with plenty of running water for at least 15 minutes.

Skin - Wash with strong soap solution immediately. Rinse well. Remove contaminated clothing at once.

Personnel Protection: Wear butyl rubber gloves, lab coat, and safety glasses. If vapor can become airborne in excess of safe limits wear self-contained breathing apparatus.

Spill Control: Absorb spill with paper towel or vermiculite and evaporate to dryness in a fume hood. Wash the spill site with strong soap solution.

Disposal: Pour on sodium bicarbonate or sand-soda ash mixture (90-10). Mix and package in heavy paper cartons. Burn at an approved disposal site.

## POTASSIUM CARBONATE

Chemical Formula:  $K_2CO_3$

Synonyms: carbonic acid, dipotassium salt; pearl ash; potash

Description: A white, granular, translucent powder; incombustible.

Toxicity:  $K_2CO_3$  is a strong caustic with high toxicity due both to poisoning and local tissue damage

Ingestion - Since vomiting results, it is improbable that acute intoxication generally occurs. However, the heart function can be seriously disturbed and convulsions, respiratory failure, and kidney damage can result, in addition to tissue damage to the mouth, throat and stomach.

Skin and eye contact - Local tissue injury and pain on contact.

Inhalation - Inhalation of the dust may cause pulmonary irritation. No permissible airborne concentration has been established.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush with fresh running water for at least 15 minutes.  
Get medical attention.

Skin - Wash with water

\*Treat the same as a thermal burn.

\*Ingestion - Dilute with large amounts of water or milk; neutralize with weak acid such as dilute vinegar or orange juice. Do not administer gastric lavage. Instill olive oil frequently. Administer demulcents. Further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat.

Spill Control and Disposal: Collect in a beaker. Dissolve in large amount of water. Add soda ash, mix, and neutralize with 6M-HCl. Wash down the drain with excess water.

Chemical Incompatibility: May be dangerous in contact with chlorine trifluoride, producing a violent reaction.



## POTASSIUM CYANIDE

Chemical Formula: KCN

Synonyms: potassium salt of hydrocyanic acid

Description: A white crysalline deliquescent solid with faint odor of bitter almonds

•Fire Hazard: Not combustible, but contact with acids releases highly flammable hydrogen cyanide gas.

Toxicity: One of the fastest acting poisons known. Toxic whether swallowed, inhaled or absorbed through the skin. Do not handle with bare hands; extremely toxic.

Inhalation - Exposure to airborne dust should not exceed a suggested limit of 5 mg per cubic meter of air. Cyanides act as powerful temporary respiratory stimulants.

Ingestion - Extremely toxic, if swallowed. Excessive dose results in a host of symptoms which may lead to difficult breathing, heart irregularities, loss of consciousness, convulsions, and death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel only, not for first aid.

Eyes - Flush with water

Skin - Wash with plenty of water and soap immediately. Remove any contaminated clothing.

\*Ingestion - Artificial respiration, if required. If conscious, have victim drink water or milk and induce vomiting.

\*Administer oxygen or an oxygen-carbon dioxide mixture. Inhale ampoule of amyl nitrate. Unless unconscious, immediately induce vomiting or administer gastric lavage. Additional follow-up and medication is found in the medical literature.

Personnel Protection: Wear long rubber gloves, safety glasses, and lab coat. If dust could become airborne above safe limits, e.g., during a spill, wear self-contained breathing apparatus. No food in the work area.

Spill Control: Evacuate the area. Eliminate all sources of ignition and flammables. Absorb the liquid with vermiculite or paper towels. Evaporate to dryness in a fume hood. Scoop solid spills, place in a beaker in a fume hood. Make alkaline with a NaOH solution. Add an excess of ferrous sulfate solution to the slurry. After one hour flush down the drain with excess water.

Disposal: Within a fume hood form an alkaline solution with NaOH. Add sodium hypochlorite to form cyanate. Dispose of to the drain with excess water.

Chemical Incompatibility: Forms hazardous combinations with chlorates, nitrites, nitrogen trichloride, sodium chlorate, chromium tetroxide, and oxidizing agents in general.

## POTASSIUM HYDROXIDE

Chemical Formula: KOH

Synonyms: potassium hydrate; caustic potash; lye; caustic alkali

Description: A white solid in pellet, stick, or cake form

Fire Hazard: Not combustible but solid form in contact with moisture or water may generate enough heat to ignite combustible materials. Fight fires involving KOH by flooding with water.

Toxicity: KOH is an extremely corrosive and penetrating chemical and its toxicity is due solely to local tissue damage, internally or externally.

Inhalation - Inhalation of the dust or mist may cause extreme pulmonary irritation. No permissible airborne concentration has been established.

Skin and eye contact - Local tissue injury, deep skin burns, and extreme pain result on contact. Conjunctivitis and corneal burns can occur.

Ingestion - Swallowing less than one ounce quantities causes intense pain and muscle spasm. Circulatory shock, asphyxia due to edema, perforation of the stomach, or infection can all lead to a quick death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Gently flush with fresh running water for at least 15 minutes. Get medical attention.

Skin - Wash in fresh, running water for at least 15 minutes. KOH penetrates the tissue and continues burning if not completely removed. Remove contaminated clothing or shoes.

\*Treat the same as a thermal burn.

Ingestion - Dilute by immediately drinking large amounts of water or milk. Do not induce vomiting or give emetic.

\*Neutralize with dilute vinegar or orange juice; do not give gastric lavage or emetics. Instill olive oil or demulcents frequently. Administer demulcents.

\*General - Administer analgesics; further treatment is symptomatic and supportive.

Personnel Protection: Avoid contact with liquid, solid, vapor, or dust. Wear rubber protective clothing and face shield or chemical goggles.

Storage: Store in a dry place.

Spill Control: Neutralize solutions with HCl and discharge to the sewer with a large excess of water. Sweep up solids, dilute with water and neutralize with 6M-HCl. Wash down the drain with a large excess of water.

Chemical Incompatibility: Can form unsafe combinations with acetic acid, acrolein, acrylonitrile, dichloroethylene, maleic anhydride, nitroethane, nitrogen trichloride, nitromethane, nitroparaffins, nitrophenol, nitropropane, phosphorus, tetrachloroethane, tetrahydrofuran, trichloroethylene, and water.

## POTASSIUM PERMANGANATE

Chemical Formula:  $\text{KMnO}_4$

Description: Dark purple crystals with sweet, astringent taste; odorless

Synonyms: Condy's crystals; purple salt; chameleon mineral; permanganic acid, potassium salt

Fire Hazard: Not flammable, but may cause fire on contact with combustibles. Explosive in contact with  $\text{H}_2\text{SO}_4$  or hydrogen peroxide. Extinguish fire with water.

Toxicity: Potassium permanganate presents a high toxic hazard by direct contact, ingestion, or inhalation. It is corrosive due to its oxidizing properties.

Inhalation - Exposure to airborne concentrations of the dust or vapor should not exceed a suggested limit of five milligrams per cubic meter of air, averaged over an eight-hour work period.

Skin and eye contact - Concentrated solutions and dry crystals may cause serious local tissue damage and systemic poisoning on contact. Poisoning may result due to absorption through intact skin or mucous membrane.

Ingestion - Deaths have resulted by ingestion of as little as ten grams. Injury to the throat has caused edema and result in death by suffocation. Chronic systemic poisoning has resulted in central nervous system damage and respiratory difficulties.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid.

Eyes - Flush with water

Skin - Wash with soap and water

\*Inhalation - Administer oxygen; further treatment is symptomatic and supportive.

\*Ingestion - Administer gastric lavage with a 2 percent solution of sodium thiosulfate followed by saline catharsis. If glottis edema is present, tracheotomy may be required. Administer demulcents such as egg white. Further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: Cover spill with reducer (hypo, a bisulfite, or a ferrous salt; but not carbon, sulfur, or a strong reducing agent). Mix well and spray with water. A sulfite or a ferrous salt will require addition of some 3M-H<sub>2</sub>SO<sub>4</sub> to promote rapid reduction. Scoop slurry into a container of water and neutralize with soda ash. Wash down the drain with an excess of water. Wash the spill site thoroughly with a strong solution containing some reducer.

Chemical Incompatibility: May form dangerous concentrations with aluminum carbide, antimony, arsenic, dimethyl sulfoxide, glycerol, hydrogen peroxide, hydrogen trisulfide, hydroxyl-amine, organic matter, phosphorus, polypropylene, sulfur, sulfuric acid, tin, titanium, and iron.

## POTASSIUM SULFATE

Chemical Formula:  $K_2SO_4$

Description: A white, granular, translucent powder

Fire Hazard: When heated to decomposition, it emits highly toxic sulfur oxide fumes.

Toxicity: A low order health hazard when ingested or in contact with the skin.

Ingestion - Since toxic quantities generally produce vomiting, it is improbable that acute poisoning will occur. However, poisoning can result in disturbance of heart rhythm and heart function, and lowered blood pressure. Convulsions, respiratory failure, and kidney damage can occur.

Skin and eye contact - Local tissue irritation can occur on contact.

Inhalation - Inhalation of the dust may cause pulmonary irritation. No permissible airborne concentration of the dust has been established.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Flush with running water

Skin - Wash with water

\*Ingestion and inhalation - Treatment is symptomatic and supportive. Cardiac resuscitation and artificial respiration may be indicated.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat.

Spill Control: Solutions - Cover with soda ash, mix, and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water.

Solid - Collect in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and treat as above.

Chemical Incompatibility: May be dangerous in contact with aluminum.



## POTASSIUM THIOCYANATE

Chemical Formula: KSCN

Synonyms: potassium rhodanate; potassium sulfocyanate; rhocya; rhodanide; aterocyn

Description: Colorless crystals; used as insecticides and used medically at times to reduce blood pressure.

Fire Hazard: When heated to decomposition, it emits highly toxic cyanide fumes.

Toxicity: Very toxic ingestion hazard. Toxicity is low by inhalation of dust or powder. It acts as a systemic poison to depress the central nervous system producing delirium, spasm of extensor muscles, convulsions, and circulatory collapse; 10 to 60 milligrams ingested at one time has caused death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage followed by saline catharsis

\*General - Administer oxygen, if necessary. Hemodialysis, if indicated. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear long rubber gloves, safety glasses, and lab coat.

Spill Control: Evacuate the lab and isolate the area during decontamination. Eliminate all sources of ignition and flammables. Absorb the liquid with vermiculite or with paper towels. Evaporate to dryness in a fume hood. For solid spills scoop into a beaker and make alkaline with sodium hydroxide solution. Add to the slurry an excess of ferrous sulfate solution. After one hour flush down the drain with excess water.

## PROPANE

Chemical Formula:  $\text{CH}_3\text{CH}_2\text{CH}_3$

Synonyms: dimethylmethane; propyl hydride; propyl dihydride

Description: A heavy, colorless, flammable gas

Fire Hazard: A highly dangerous fire hazard when exposed to heat or flame. The explosive range is 2.3 to 9.5 percent by volume in air; the flash point is  $-104^\circ\text{C}$  ( $-156^\circ\text{F}$ ). Spray fire with water until leak is stopped.  $\text{CO}_2$  or dry chemical can also be used.

Toxicity: Propane is slightly toxic by inhalation, acting as a central nervous system depressant and narcotic. Exposure to the gas should not exceed 1000 parts per million parts of air (ppm) averaged over an eight-hour work period. Odor is not detectable below 20,000 ppm; 100,000 ppm produces dizziness in a few minutes. High concentrations can cause asphyxiation due to exclusion of sufficient oxygen.

Treatment of Overexposure: Contact Medical Services immediately. Administer oxygen and artificial respiration, if indicated. No permanent effects following recovery have been reported. Further treatment is supportive and symptomatic.

Leak Control: Keep concentration of gas below the explosive mixture range by forced ventilation. Wear self-contained breathing apparatus. Remove container to an open area and allow dissipation to the atmosphere.

Storage: Store outdoors when possible, but not in direct sunlight. Provide good ventilation.

## PROPYLENE

Chemical Formula:  $\text{CH}_2\text{:CHCH}_3$

Synonyms: propene; methylethylene

Description: A colorless, flammable gas with mild odor

Fire Hazard: Propylene is dangerous when exposed to heat or flame. The explosive range is 2.0 percent to 11.1 percent by volume. The vapors are heavier than air and may collect in low areas. Extinguish fires using  $\text{CO}_2$ , water spray, or dry chemical. Containers may explode in fires.

Toxicity: Propylene presents a moderate hazard by inhalation. It acts as a narcotic or central nervous system depressant. Exposures to this gas should not exceed a suggested limit of 4000 parts per million parts of air averaged over an eight-hour work period. It is not an irritant, but can cause irregularity in heart rate. At high concentrations, it acts as an asphyxiant by excluding oxygen.

Treatment of Overexposure: Contact Medical Services immediately. Administer oxygen and artificial respiration as required. Further treatment is supportive and symptomatic.

Personnel Protection: Keep vapor concentrations within safe limits by containment and ventilation. If this is not possible, e.g., during a leaking container incident, wear a self-contained breathing apparatus.

Leak Control: Remove the container to an open area and allow dissipation to the atmosphere.

Chemical Incompatibility: Can form dangerous combinations with nitrogen dioxide, nitrogen tetroxide, or nitrous oxide. Olefins in general form unsafe combinations with inorganic acids, halogenated compounds, halogens, and molten sulfur.

## PYRIDINE

Chemical Formula:  $\text{N}(\text{CH})_4\text{CH}$

Synonyms: azabenzene; azine

Description: A slightly yellow or colorless liquid with a sharp, nauseating odor at 10 ppm and burning taste. The odor can be detected at less than one ppm but the sense of smell is rapidly blunted and cannot be relied on as a warning of its presence.

Fire Hazard: A serious fire hazard with a flash point of 20° C (68° F) and autoignition temperature of 482° C (900° F). Flammable from 1.8 to 12.4 percent in air. Vapor is heavier than air. Extinguish fires with dry chemical, alcohol foam, or CO<sub>2</sub>. Water spray may be ineffective, but may be used to disperse the vapors and flush spills away and dilute to nonflammable mixtures.

Toxicity: Pyridine is toxic by ingestion and inhalation. It is irritating to the skin and eyes on contact. Can paralyze the eye muscles, vocal chords, and bladder.

Inhalation - Exposure to the vapors should not exceed five parts per million parts of air (ppm) averaged over an eight-hour work period. It depresses the central nervous system, causes lung edema, and irritates the mucous membrane, causing asthmatic breathing.

Ingestion - It produces injury to the liver and kidneys and causes local gastric irritation. Several ounces have proved to be fatal.

Skin and eye contact - Severe skin effects and eye damage can result from prolonged, repeated contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Flush with water for at least 15 minutes.

Skin - Wash with soap and water. Remove contaminated clothing and shoes. Wash before reusing.

\*Ingestion - Administer gastric lavage followed by saline catharsis. Administer thiamine hydrochloride.

\*General - Further treatment is symptomatic and supportive. Administer oxygen, and/or artificial respiration if required.

Personnel Protection: Wear butyl rubber gloves, chemical goggles, and lab coat. Maintain vapor levels at safe levels by process enclosure and ventilation. When vapors may exceed safe levels, e.g., during spills, wear self-contained breathing apparatus.

Storage: Outside or detached storage is preferred. Isolate from strong oxidizing agents.

Spill Control: Absorb on paper towels. Allow to evaporate to dryness in a fume hood. Wash spill site with strong soap solution.

Disposal: Dispose out in the opening at an approved disposal site by washing away with water into the earth or by burning. On no account throw into the lab drains nor discard in the waste bin.

Chemical Incompatibility: Can form unsafe combinations with nitric acid, chlorosulfonic acid, chromium trioxide, maleic anhydride, oleum, perchromate, propiolactone, silver perchlorate, and sulfuric acid.

## QUINOLINE

Chemical Formula:  $C_5H_4CNC_3H_3$

Synonyms: chinoline; 1-azanaphthalene; 1-benzazine; 1-benzine; benzo (b) pyridine; leucol; leucoline; leukol

Description: A colorless liquid with a peculiar penetrating odor. It darkens with age.

Fire Hazard: Combustible with an ignition temperature of 480° C (896° F). Extinguish fires with dry chemical or CO<sub>2</sub>.

Toxicity: Quinoline is highly toxic by ingestion and inhalation and is a high eye contact hazard. It can be absorbed through the intact skin. It depresses the central nervous system causing respiratory distress, prostration, and coma. Chronic exposure has caused kidney and liver damage.

Inhalation - No threshold limit value for breathing airborne vapors has been recommended. Tests have shown that 17 parts of vapor per million parts of air (ppm) for six hours have not produced bad effects; 4000 ppm has proved lethal within 5-1/2 hrs.

Ingestion - Five grams ingested proved to be a lethal dose.

Skin and eye contact - Quinoline produces moderate irritation of the skin and mucous membrane. It has produced inflammation of the retina of the eye but no opacity to the lens.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Immediately flush with running water

Skin - Wash with plenty of soap and running water. Remove contaminated clothing and wash in strong soap solution.

General - The literature available did not recommend any medical treatment. The chemical characteristics would suggest gastric lavage with water followed by cathartics. Additional treatment would be supportive and symptomatic.

Personnel Protection: Wear butyl rubber gloves, lab coat, and chemical goggles. If containment and ventilation cannot maintain vapors in work area within safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Storage: Store in a well-ventilated, cool place.

Spill Control: Absorb spill on paper towels. Allow to evaporate to dryness in a fume hood. Wash spill site with strong soap solution.

Chemical Incompatibility: Hazardous when in contact with perchromates.

## SELENIUM DIOXIDE

Chemical Formula:  $\text{SeO}_2$

Description: white or steel gray to reddish, lustrous, crystalline powder or needles

Toxicity: Selenium dioxide is a general tissue poison similar in action to arsenic. It is highly toxic when inhaled or ingested, and less toxic when absorbed through the intact skin. Acute poisoning may lead to convulsions and death. Prolonged low level exposure can cause liver, kidney, and heart muscle damage. It is a suspected cause of cancer of the liver and thyroid.

Inhalation - Exposure to the dust or vapor should not exceed 0.2 milligrams per cubic meter of air averaged over an eight-hour work period. Dusts or fumes can cause serious respiratory tract irritation and pulmonary edema and pneumonitis.

Ingestion - A host of symptoms occur on swallowing toxic amounts.

Skin and eye contact - It is a potent skin and eye irritant leading to conjunctivitis and cornea damage and skin dermatitis, eczema, and burns.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Flush with water

Skin - Wash with water followed by a \*wash with 10 percent aqueous sodium thiosulfate.

\*Treat skin burns as usual.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Administer oxygen intermittently for 30 minutes. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber or plastic gloves, chemical goggles, and lab coat. Handle in fume hood or well ventilated area. If level of airborne dust or vapor may exceed safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus or mechanical filter respirator depending on form of containment.

Spill Control: Absorb on paper and contain in air-tight container. Wash spill site with soap solution.



## SILANE

Chemical Formula:  $\text{SiH}_4$

Synonyms: monosilane; silicon tetrahydride; silicane

Description: A gas with a repulsive odor

Fire Hazard: A dangerous fire and explosion hazard; flash point about  $-200^\circ \text{C}$ ; by chemical reaction with oxidizers it spontaneously ignites. When heated it emits highly toxic fumes. It is flammable spontaneously in air. Keep dolomite powder or dry graphite available for fire fighting.

Toxicity: It is a high toxic hazard by inhalation, or direct contact due to its irritating characteristics.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. Handling preferable by using a body shield.

Leak Control: Eliminate all sources of ignition. Remove to an approved disposal site for burning or place the container in a fume hood and allow to dissipate to the atmosphere.

Chemical Incompatibility: Hazardous in presence of air or of chlorine.

## SILICON TETRACHLORIDE

Chemical Formula:  $\text{SiCl}_4$

Synonyms: silicon chloride; tetrachlorosilane

Description: A colorless, clear, mobile, fuming liquid with a suffocating odor.

Fire Hazard: When heated to decomposition forms highly toxic  $\text{HCl}$  fumes. Will react with water to produce heat and toxic corrosive fumes.

Toxicity: Silicon tetrachloride is highly toxic by ingestion and inhalation. It acts as a strong tissue irritant. The effects of long term exposure to low concentrations is not known. It has been used in warfare as an irritant gas. It is highly irritating to the skin and eyes on contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel, and are included for information only, not for first aid action.

Eyes - Flush with plenty of water for at least 15 minutes. Get medical attention.

Skin - Wash with plenty of water for 15 minutes. Do not attempt to neutralize with alkalies since this will generate heat and add to the distress.

\*Ingestion - Avoid lavage or emetics. Administer, by mouth, diluants such as water and neutralizer such as milk of magnesium in large quantities, followed by demulcents such as milk or olive oil.

\*General - Opiates to relieve pain. Subsequent treatment is symptomatic and supportive, with bed rest.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. When containment and ventilation (e.g., fume hood) cannot maintain vapor levels below safe levels, wear self-contained breathing apparatus.

Spill Control: Cover spill with excess sodium bicarbonate. Scoop the mixture into a large beaker of water and let stand for a few minutes. Slowly pour into the drain with plenty of water. The site of the spill should be washed with soapy water.

Disposal: Small amounts may be spread on the ground at an approved disposal site and allowed to evaporate. Larger amounts can be burned or spread on the ground and flooded with water.

Chemical Incompatibility: Hazardous in contact with potassium or sodium.

## SILVER NITRATE

Chemical Formula:  $\text{Ag NO}_3$

Synonyms: nitric acid, silver salt; lunar caustic

Description: A colorless to grayish black transparent, odorless crystal with a bitter, caustic taste. Not flammable.

Fire Hazard: Has strong oxidizing nature and flames up when contacted with combustibles and oxidizing materials.

Toxicity: Silver nitrate is a moderate inhalation hazard and is very toxic by ingestion. Systemic poisoning results in degenerative changes to the liver and kidneys. Its dust irritates the eyes, skin, and respiratory system.

Inhalation - Exposure to airborne silver nitrate dust should not exceed 0.01 micrograms per cubic meter of air averaged over an eight-hour work period.

Ingestion - Due to its caustic nature, silver nitrate can cause severe gastrointestinal inflammation, shock, convulsions, and death if swallowed in amounts as small as two grams.

Skin and eye contact - Irritation and ulceration of the skin and permanent damage to the eyes can result from contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Section marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Promptly flush with plenty of water.

Skin - Promptly wash with soap and water.

\*Ingestion - Administer gastric lavage with a dilute sodium chloride solution followed by saline or sodium sulfate catharsis. Milk may then help relieve gastric irritation.

\*General - Additional treatment is symptomatic (such as for shock) and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. No eating or smoking where it is handled.

Storage: Keep tightly contained and store in a dark, cool place.

Spill Control: Cover solutions with soda ash, mix and scoop into a beaker of water. Neutralize with 6M-HCl and wash down the drain with excess water. Collect solids in a beaker. Dissolve in a large amount of water. Add soda ash, mix, and neutralize with 6M-HCl. Wash down the drain with excess water.

Chemical Incompatibility: Hazardous when interacted with acetylene, ammonium hydroxide, arsenic, calcium carbide, charcoal, chlorine trifluoride, cuprous acetylide, ethyl alcohol, phosphine, phosphorus isocyanate, plastics, or sulfur.

## SODIUM CHROMATE

Chemical Formula:  $\text{Na}_2\text{CrO}_4$

Description: A yellow, translucent crystalline solid

Toxicity: Highly toxic by ingestion, inhalation, and contact with the skin and eyes. It is highly irritating and corrosive, forming deep, penetrating skin ulcers. Sodium chromate is a carcinogen, and is associated with lung cancer.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with running water for at least 15 minutes.

Skin - Wash with soap and water. Treat skin burns like any acid burn. External lesions may be scrubbed with dilute (2 percent) sodium hyposulfite solution; antihistamines and cortisone locally. Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield, and lab coat.

Spill Control: Cover spill with a reducer (hypo, a bisulfite, or a ferrous salt - but not carbon, sulfur, or a strong reducing agent). Mix well and spray with water. A sulfite or ferrous salt will require addition of some 3M- $\text{H}_2\text{SO}_4$  to promote rapid reduction. Scoop the slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash the spill site thoroughly with a soap solution containing some reducer.

## SODIUM CYANIDE

Chemical Formula: NaCN

Description: white, crystalline powder, with almond-like odor.

Fire Hazard: Not flammable. If involved in fires use water as the extinguisher. Liberates highly toxic and flammable HCN gas when heated.

Toxicity: One of the fastest poisons known, and extremely toxic if swallowed; less so by inhalation or by absorption through the intact skin. Acute poisoning by exposure to a large dose in a short period of time is the problem rather than chronic exposure to small doses. Poisoning can result in loss of consciousness, convulsions, respiratory arrest, and death.

Inhalation - Exposure to airborne dust or vapor should not exceed 5 milligrams per cubic meter of air, averaged over an eight-hour work period. It is irritating to the upper respiratory tract. Cyanides act as a powerful temporary respiratory stimulant.

Ingestion - Primary mode of poisoning

Skin - In soluble form it is absorbed through the intact skin; causes skin eruptions and rash on prolonged contact. Do not handle with the bare hands. Can burn the eyes.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not as first aid actions.

Eyes - Flush with plenty of water

Skin - Wash with plenty of soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Immediately induce vomiting if the victim is conscious, or administer gastric lavage.

\*General - Administer artificial respiration and oxygen, if necessary; 10 cc of 3 percent sodium nitrite intravenously over a two-minute period; epinephrine; inhale amyl nitrite. Detailed medical treatment is available in the literature.

Personnel Protection: Wear long rubber gloves, chemical goggles, and lab coat. If dust or vapors could become airborne in amounts in excess of safe limits, wear self-contained breathing apparatus. No smoking or eating in the area.

Storage: Store in cool, dry, well-ventilated area. Separate from acids and oxidizing materials.

Spill Control: Evacuate the area during decontamination. Absorb any liquid with vermiculite or paper towels. Sweep solids onto paper. Evaporate to dryness in a fume hood. Or, scoop into a large beaker, make alkaline with sodium hydroxide, and add an excess of ferrous sulfate solution. After one hour flush down the drain with excess water.

Chemical Incompatibility: Dangerous when combined with nitrites and nitrates. Contact with acids or water releases highly flammable hydrogen cyanide. Hazardous reactions take place with strong oxidizing materials.



## SODIUM DICHROMATE

Chemical Formula:  $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$

Synonyms: sodium acid chromate; dichromic acid, disodium salt

Description: Red to orange crystals; odorless

Fire Hazard: Not flammable but may cause fire on contact with combustibles.

Toxicity: Sodium dichromate is a high health hazard due to its corrosive action on tissues, and is equally toxic whether inhaled, ingested, or in contact with the skin or eyes.

Inhalation - Exposure to the airborne powder should not exceed 0.5 milligrams per cubic meter of air averaged over an eight-hour work period. Chromate salts have been associated with cancer of the lungs. Lesions and ulceration of the nasal mucous membrane with perforation of the nasal septum have occurred. Causes difficult breathing.

Ingestion - The mean lethal dose is about 10 grams. Inflammation of the GI tract, vascular collapse, and coma may result.

Skin Contact - Deep and penetrating lesions and ulcers can occur if the chemical is not removed from the skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes and skin contact - Wash the eyes with water; wash the skin with soap and water. For dermatitis \*administer antihistamines, and cortisone locally. Remove contaminated clothing and shoes.

Ingestion - If victim is conscious, have him drink water or milk. Do not induce vomiting.

\*General - Additional treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, face shield and lab coat. If dust or vapor becomes airborne in excess of safe limits, e.g., during clean-up of a spill, wear self-contained breathing apparatus.

Storage: Store tightly closed in a dry place away from combustibles.

Spill Control: Cover spill with a reducer (hypo, a bisulfite, or a ferrous salt, but not carbon, sulfur, or strong reducing agents). Mix well and spray with water. A sulfite or ferrous salt will require the addition of  $3\text{M-H}_2\text{SO}_4$  to promote rapid reduction. Scoop the slurry into a container of water and neutralize with soda ash. Wash down the drain with excess water. Wash the spill site with a soap solution containing some reducer.

Chemical Incompatibility: Can be dangerous in contact with hydrazine, carbide, amines in general, slaked lime, mercury cyanide, and oxidizable materials.

## SODIUM HYDROXIDE

Chemical Formula: NaOH

Synonyms: caustic soda; sodium hydrate; white caustic; lye; caustic flake

Description: A white solid in stick, flake, or powder form; odorless

Fire Hazard: Not combustible, but the solid form in contact with water or moisture may generate sufficient heat to ignite combustible material. Extinguish fire by flooding with water using care not to splash too much.

Toxicity: NaOH is a corrosive and penetrating chemical and its toxicity is due to local tissue damage.

Inhalation - Exposure to airborne dust or vapor should not exceed 2 milligrams per cubic meter of air averaged over an eight hour work period. Inhalation of the dust or vapor may cause lung irritation and damage with pneumonitis.

Skin and eye contact - Skin burns, dermatitis, deep ulceration and scarring can result if the chemical is not promptly removed. Contact with the eyes can produce very rapid injury including corneal burns.

Ingestion - Swallowing NaOH causes damage to any tissue contacted, including perforation and scarring. Less than 10 grams has proved lethal. Death may be due to circulatory shock, asphyxia due to throat edema, perforation of esophagus or stomach, or due to infection.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel and are included for information only, not for first aid action.

Eyes - Gently flush with warm running water for at least 15 minutes. Get medical attention.

Skin - Wash in fresh, running water for at least 15 minutes. Remove contaminated clothing and shoes.

\*Treat the same as a thermal burn.

Ingestion - Dilute by immediately drinking large amounts of water or milk. Do not induce vomiting.

\*Neutralize with dilute vinegar or orange juice; do not give gastric lavage or emetics. Instill olive oil frequently. Administer demulcents.

\*General - Administer analgesics; further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles or face shield, and lab coat. If dust may exceed safe airborne levels, e.g., during clean-up of a spill, wear an approved mechanical filter respirator.

**Storage:** Store in a dry place. Separate from acids, metals, organic peroxides and easily ignitable materials.

**Spill Control:** Sweep solid up, dilute and neutralize with 6M-HCl in a large container. Wash down the drain with a large excess of water. Neutralize solution spills and dispose as above.

**Chemical Incompatibility:** It is particularly dangerous with acetic acid, acetaldehyde, acetic anhydride, acrolein, acrylonitrile, aluminum, chlorine trifluoride, chlorohydrin, dichloroethylene, hydrochloric acid, hydrofluoric acid, hydroquinone, nitric acid, nitroethane, nitromethane, nitroparaffins, oleum, phosphorus, phosphorus pentoxide, sulfuric acid, tetrahydrofuran, trichloroethylene, and water.

## SODIUM NITRITE

Chemical Formula:  $\text{NaNO}_2$

Synonyms: nitrous acid, sodium salt; filmerine; diazotizing salts

Description: A slightly yellow or white solid in crystalline, sticky or powder form.

Fire Hazard: Explodes when heated over  $538^\circ \text{C}$  ( $1000^\circ \text{F}$ ); in contact with organic material it will cause ignition by friction. Extinguish with water spray; beware of scattering of molten material.

Toxicity: Sodium nitrite presents a toxic hazard either by inhalation or ingestion. There is a large variation in susceptibility.

Ingestion - Frequent small doses cause lowered blood pressure, headache, and visual disturbances among other symptoms. Larger doses may lead to collapse and coma.

Inhalation - No safe airborne concentration limits of exposure have been established as yet.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Gastric lavage with a 1:5000 concentration of potassium permanganate followed by saline catharsis. Avoid vasoconstrictors, e.g., epinephrine.

General - Artificial respiration and oxygen, if necessary.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat.

Spill Control: Solids - Collect in a beaker, dissolve in a large amount of water, add soda ash, mix and neutralize with 6M-HCl. Wash down the drain with excess water.

Solutions - Cover with soda ash, mix, scoop into a beaker of water and neutralize with 6M-HCl. Wash down the drain with excess water.

Chemical Incompatibility: Can form dangerous combinations with ammonium salts, cellulose, cyanides, lithium, sodium thiosulfate, hydrazine, thiocyanates, and combustible materials.

## SODIUM SULFIDE

Chemical Formula:  $\text{Na}_2\text{S}$

Synonym: sodium sulfuret; sodium monosulfide

Description: Colorless, clear crystals becoming, on exposure to air, yellow or brick red. Flammable. Rotten egg odor. Combustible, toxic gasses may be produced in fire.

Fire Hazard: Moderately flammable. Finely divided powder can form explosive mixtures with air. Heated it can emit toxic hydrogen sulfide or sulfur dioxide gases. Extinguish fire with water. However, contact with water can result in emission of hydrogen sulfide.

Toxicity: Sodium sulfide is a strong irritant to the skin and tissue. On contact with tissue, it liberates hydrogen sulfide, a highly toxic gas. If ingested, the stomach acids also cause the release of hydrogen sulfide with subsequent systemic poisoning.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not for first aid.

Eyes - Flush with running water.

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage followed by demulcents and saline catharsis.

Personnel Protection: Wear rubber protective clothing, chemical goggles, or face shield. If fire or spill generates airborne dust or vapors, wear self-contained breathing apparatus.

Storage: Store separately from acids, oxidizing materials, and possible sources of ignition. Store in cool, dry location.

Spill Control: Eliminate all sources of ignition. Add ferric chloride solution to the spill and stir until the formation of ferric sulfide is complete. Add slight excess of soda ash. Scoop up and wash into drain with excess water. Wash the spill site with soap solution.

Chemical Incompatibility: Dangerous if reacted with carbon; m-chloroaniline diazonium salt; 4-chloro-o-toluidine diazonium chloride salt; diazonium salts; N,N-dichloromethyl amine; or water.

## SODIUM SULFITE

Chemical Formula:  $\text{Na}_2\text{SO}_3$

Synonyms: sulfurous acid, sodium salt; hydrogen sulfite sodium; sodium acid sulfite; sodium bisulfite; sodium hydrosulfite

Description: A white or colorless crystal or powder; when heated to decomposition it emits highly toxic fumes or sulfur dioxide; odorless

Toxicity: Moderately toxic by ingestion or by inhalation of the powder. It acts as an irritant and as a poison causing central nervous system depression.

Inhalation - Sodium sulfite can produce superficial destruction of the mucous membrane. Contact with acid.

Ingestion - Ingestion produces irritation, colic, circulatory disturbance, central nervous system depression, and possibly death. The estimated fatal dose is ten grams.

Skin and eye contact - Repeated or prolonged contact is irritating and superficially corrosive.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with water for at least 15 minutes

Skin - Wash with soap and water

Ingestion - If victim is conscious have him drink water or milk.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. Work in hood if possible.

Storage: Keep containers closed and store in a cool area.

Spill Control: Cover spill with soda ash or sodium bicarbonate. Mix and spray with water. If effervescent, wait until reactions are complete. Scoop into a large beaker and cautiously add equal volume of calcium hypochlorite (reaction may be vigorous). Add more water, stir, and allow to stand for one hour. Dilute and neutralize (litmus paper) with 6M-HCl or 6M NaOH as required. Transfer to the drain with an excess of water.



## STODDARD SOLVENT

Chemical Formula: A mix of straight and branched chain hydrocarbons (C<sub>9</sub>-C<sub>12</sub>) naphthenes and higher aromatics. Contains about 85 percent nonane and 15 percent trimethylbenzene.

Synonyms: safety solvent; Varsol; varnoline; white spirits; mineral spirits; solvent distillate; naptha safety solvent

Description: A clear, colorless liquid

Fire Hazard: A moderate fire hazard with an explosive range in air of 1.1 percent to 6 percent; the flash point is 38° C to 44° C. Extinguish fire with foam, CO<sub>2</sub>, dry chemical, or water.

Toxicology: A moderate health hazard by fume inhalation and by contact. It is a serious health hazard by ingestion. Acting as a systemic poison, it can damage the liver, kidneys, bone marrow, and spleen. At high dose levels, it can alter nerve function, depress the central nervous system, and cause coma and death.

Inhalation - Exposure to Stoddard solvent vapors should not exceed 500 parts per million parts of air (ppm) averaged over an eight hour work period. It causes intense local irritation, pulmonary edema, pulmonary bleeding and bronchial pneumonia. 10,000-15,000 ppm produces narcosis and greater than 15,000 ppm has resulted in death.

Ingestion - Greater than 10 ml may be fatal.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel, and are included here for information, not first aid action.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Gastric lavage only if within 15 minutes of ingestion. Give 30 ml syrup of ipecac followed by 200-500 ml of water for emesis. In either case, prevent aspiration by keeping head low. Follow by saline catharsis.

\*General - Administer artificial respiration using oxygen, if necessary. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves, face shield, and lab coat. If vapors may exceed safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill with paper towels. Evaporate to dryness in a fume hood.

## SULFUR DIOXIDE

Chemical Formula:  $\text{SO}_2$

Synonyms: sulfurous acid anhydride; sulfurous oxide

Description: A colorless, irritating, nonflammable gas with a sharp, pungent odor associated with burning sulfur. Detectable by odor at less than one ppm.

Toxicity: It is a high health hazard which is intensely irritating to the eyes, throat, and upper respiratory tract. Forms an acid on contact with tissue moisture.

Inhalation - Exposure to the gas should not exceed five parts per million parts of air (ppm) averaged over the eight hour work period. It is detectable by taste at less than 1 ppm and by odor at about 3 ppm. 8-12 ppm is irritating, and 400 ppm is immediately hazardous to life on 1/2 to 1 hour exposure; 3000 ppm is fatal on 5-10 minutes exposure. Death can result from systemic acidosis (at low concentrations), pulmonary edema (moderate concentrations), or respiratory paralysis (high concentrations). Some people are very sensitive to  $\text{SO}_2$ .

Eye contact - It can produce eye inflammation, and at higher concentrations damage the cornea.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Flush eyes with water; \*then instill olive oil.

Skin - Wash with soap and water; \*treat skin chemical burns the same as thermal burns.

\*General - As necessary, provide oxygen by the intermittent, positive-pressure method; administer bronchodilators and decongestants; cortisone; codeine for cough; sedation, if necessary.

Personnel Exposure: Maintain gas level within safe levels by process enclosure and ventilation. Wear chemical goggles and rubber gloves when working with the gas. Wear self-contained breathing apparatus when concentrations of gas in work area exceed safe levels, e.g., during a leak.

Storage: Outdoor or detached storage in well-ventilated area preferred.

Leak Control: Evacuate personnel. Bubble the leaking gas through a calcium hypochlorite solution, if possible. Include a trap in the line to prevent the solution from being sucked back into the cylinder.

Disposal: Bubble gas into water. Add strong solution of potassium permanganate until a permanent pink color remains. It is then safe to pour away.

Chemical Incompatibility: Forms dangerous combinations with acrolein, aluminum, cesium monoxide, chlorates, chlorine trifluoride, chromium, ferrous oxide, fluorine, manganese, potassium chlorate, rubidium carbide, sodium, sodium carbide, and stannous oxide.

## SULFUR HEXAFLUORIDE

Chemical Formula:  $\text{SF}_6$

Synonym: sulfur fluoride

Description: A colorless, odorless gas.

Fire Hazard: It is a dangerous fire hazard. Incombustible but when heated to decomposition, it emits highly toxic fumes of fluorides and sulfur oxides.

Toxicity: It is a slight inhalation hazard. In the pure state it is chemically and physiologically inert, but in the form ordinarily available has lower sulfur fluoride impurities which may be very toxic, very reactive chemically, and corrosive. These impurities can hydrolyse with moisture and produce hydrogen fluoride, a highly toxic and caustic material.

Inhalation - Exposure to this gas should not exceed 1000 parts per million parts of air averaged over an eight-hour work period.

Leak Control: Place container within a fume hood and allow to leak off at as low a rate as possible or flow the gas into a solution of caustic soda and slaked lime.

Chemical Incompatibility: Can form dangerous combination with disilane resulting in explosion. Halogenated compounds in general form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## SULFURIC ACID

Chemical Formula:  $\text{H}_2\text{SO}_4$

Synonyms: battery acid; dipping acid; hydrogen sulfate; oil of vitriol; fertilizer acid; spirit of sulfur

Description: A clear, colorless, odorless, oily liquid. Darkens with impurities.

Fire Hazard: Non-flammable but in concentrated form it can ignite combustibles on contact. When heated, it emits highly toxic fumes. Extinguish fires with dry chemical or  $\text{CO}_2$ .

Toxicity: Sulfuric acid is a high health hazard. Concentrated solutions are rapidly destructive to tissues, producing severe burns.

Inhalation - Exposure to the vapors or mists should not exceed 1 milligram per cubic meter of air averaged over an eight-hour work period. Inhalation of concentrated vapor can cause bronchitis, and lung damage; and hot vapors may cause immediate unconsciousness.

Ingestion - In dilute form it is not a systemic poison; in concentrated form severe injury and even death may result.

Eye and skin contact - Repeated contact with dilute solutions produces corneal damage to the eye and dermatitis and ulceration to the skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) below are for the attention of medical personnel and are included here only for information, not for first aid.

Eyes - Flush with plenty of water for at least 15 minutes.

Skin - Wash with prolonged running water and follow with soap and water, \*then mild alkaline solutions. Remove contaminated clothing.

Ingestion - Do not induce vomiting; wash out mouth with water and drink plenty of water and milk with egg whites, if available. \*Gastric lavage followed by demulcents.

\*General - Treat for shock, if necessary; morphine for pain; bronchodilators; codein for cough; oxygen therapy with 5 percent solution of sodium bicarbonate as an aerosol. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, lab coat, rubber apron, and chemical goggles. Emergency eye-wash fountains should be available in the work area. If vapors can exceed safe levels, wear the appropriate chemical cartridge respirator or self-contained breathing apparatus.

Storage: Protect containers from damage and contact with water.

Spill Control: Cover the spill with sodium bicarbonate or a soda ash-slaked lime mixture (50-50). Mix and add water if necessary to form a slurry. Wash down the drain with excess water. Wash spill site with soda ash solution.

Chemical Incompatibility: Can form dangerous combinations with many chemicals including acetic anhydride, acetonitrile, acrolein, acrylonitrile, alcohols, ammonium hydroxide, butyraldehyde, carbides, chlorates, diisobutylene, epichlorohydrin, ethylenimine, hydrochloric acid, isoprene, mercuric nitride, powdered metals, nitrotoluene, perchlorates, perchloric acid, picrates, potassium permanganate and chlorate, propylene oxide, sodium carbonite, sodium hydroxide and water.

## SULFUR MONOCHLORIDE

Chemical Formula:  $S_2Cl_2$

Synonyms: disulfur dichloride; sulfur chloride; sulfur subchloride; thiosulfurous dichloride

Description: An amber to yellowish red, oily, fuming liquid with a penetrating odor. On contact with water it decomposes to hydrochloric acid and sulfur dioxide.

Fire Hazard: Combustible. Flash point is  $118^{\circ}C$  ( $245^{\circ}F$ ). Extinguish fire with dry chemical or  $CO_2$ .

Toxicity: It is highly toxic by inhalation and ingestion and is a strong tissue irritant on contact.

Inhalation - Exposure to the vapors should not exceed one part per million parts of air (ppm) averaged over an eight-hour work period. Two to 9 ppm are irritating and 150 ppm was fatal to mice after one minute of exposure.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Immediately flush with plenty of water for 15 minutes

Skin - Wash with plenty of soap and water. Remove contaminated clothing immediately.

\*Treat skin burns as usual.

\*General - Administer oxygen with intermittent positive pressure. Administer codeine for cough and sedate as necessary. Further treatment is symptomatic and supportive.

Personnel Protection: Wear long rubber gloves, safety glasses or chemical goggles, and lab coat. If airborne vapors are likely to exceed safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Storage: Keep containers tightly closed and separate from water.

Spill Control: Cover spill with dry vermiculite, sodium bicarbonate, or a mix of soda ash and slaked lime (50-50). Mix and spray water cautiously from an atomizer. Beware of a flash fire. Scoop up and add slowly to a large container of water - if too active continue spraying. When the reaction is complete, neutralize (litmus test) with 6M- $NH_4OH$  or 6M-HCl and wash down the drain with a large excess of water. Wash the spill site with soap solution.

Chemical Incompatibility: Can form dangerous combinations with chromyl chloride, organic matter, phosphorus trioxide, sodium peroxide, and water.



## SULFUR TRIOXIDE

Chemical Formula:  $\text{SO}_3$

Synonyms: sulfuric acid anhydride; sulfuric oxide; Sulfan

Description: A colorless solid, liquid, or gas; melting point  $16.8^\circ \text{C}$  ( $62^\circ \text{F}$ ) and boiling point  $44.8^\circ \text{C}$  ( $113^\circ \text{F}$ ). The solid readily absorbs moisture and emits dense white fumes.

Fire Hazard: Dangerous; when heated to decomposition it emits highly toxic fumes. Can react explosively with water. Fire risk in contact with organic material.

Toxicity: Sulfur trioxide is a high inhalation, ingestion, and irritant hazard. It is highly irritating and corrosive on contact with tissues.

Inhalation - It is recommended that exposure to airborne dust or vapors not exceed 0.3 parts per million (ppm) of air averaged over an eight-hour period. It is tolerable at 1.5 ppm for five minutes, producing a choking sensation except in persons routinely exposed who can build up a tolerance to it. Higher concentrations can produce spasm of the larynx and lung edema, leading to asphyxia. In animal tests as low as 60 ppm proved fatal; long-term exposure to low concentrations can produce ulcers and gastritis.

Skin and Eyes - Skin contact can produce burns and ulcerations. Eye contact can result in inflammation, swelling, and opacities in the cornea.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Immediately flush with plenty of water for at least 15 minutes.

Skin - Wash with soap and water thoroughly.

\*Treat burns in the same manner as thermal burns.

\*General - Administer oxygen under positive pressure and artificial respiration if needed. Watch for lung edema.

Personnel Protection: When vapors may exceed safe airborne concentrations, e.g., during a spill wear an approved gas mask with acid gas canister and ultra-fine filter or a self-contained breathing apparatus. Wear rubber or neoprene protective clothing and chemical goggles.

Storage: Avoid storage on wooden floors.

Spill Control: Cover with sodium bicarbonate or a 50-50 mixture of soda ash and slaked lime. Mix and add enough water to form a slurry. Scoop up, dilute with water and wash down the drain with excess water. Wash the spill site with soda ash solution.

Chemical Incompatibility:  $\text{SO}_3$  in excess with tetrafluoroethylene can decompose explosively to form carbonyl fluoride and sulfur dioxide. Violent reactions can also occur with dioxygen difluoride, nitrile chloride, and anhydrous perchloric acid.

## SULFURYL CHLORIDE

Chemical Formula:  $\text{SO}_2\text{Cl}_2$

Synonyms: chlorosulfuric acid; sulfonyl chloride; sulfuric chloride; sulfuric oxychloride

Description: A colorless to light yellow liquid with a pungent odor which rapidly decomposes in hot water to sulfuric and hydrochloric acids; it has an acrid odor. Not flammable.

Toxicity: It is highly toxic by ingestion, inhalation, and skin contact due to its strong irritating and corrosive qualities.

Inhalation - Exposure to the vapors is not recommended to exceed one milligram per cubic centimeter of air (less than one part per million parts of air). Bronchitis and lung inflammation can result from overexposure.

Eye contact - Damage to the cornea can occur, as well as conjunctivitis.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Immediately flush with plenty of water for 15 minutes.

Skin - Wash with plenty of soap and water. \*Treat skin burns as usual. Remove contaminated clothing and shoes.

Ingestion - If conscious, have the victim drink water or milk; do not induce vomiting.

\*General - Administer oxygen with intermittent positive pressure for inhalation exposure. Also, a five percent solution of sodium bicarbonate as an aerosol may be used. Administer bronchodilators and decongestants as necessary. Further treatment is supportive and symptomatic.

Personnel Protection: Avoid contact with liquid and gas. Wear rubber protective clothing and chemical goggles. If vapors in the work area exceed safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Cover spill with dry vermiculite, sodium bicarbonate, or a mix of soda ash and slaked lime (50-50). Mix and spray water cautiously from an atomizer. Beware of a violent reaction with water with the emission of hydrogen chloride and sulfur dioxide gases. Scoop up and add slowly to a large container of water - if too active continue spraying. When the reaction is complete, neutralize (litmus test) with 6M- $\text{NH}_4\text{OH}$  or 6M-HCl and wash down the drain with a large excess of water. Wash the spill site with soap solution.

Chemical Incompatibility: Forms dangerous combinations with water, lead dioxide, dimethyl sulfoxide, and o-nitrobenzoylacetic acid.

## P-TERPHENYL

Chemical Formula:  $(C_6H_5)_2C_6H_4$

Synonym: 1,4-diphenyl benzene

Description: A liquid with a flash point of 207° C (405° F).

Fire Hazard: Flammable. Extinguish fires with dry chemical or CO<sub>2</sub>.  
Water or foam may cause frothing.

Toxicity: Details on toxicity are sketchy but p-terphenyl is considered highly toxic when ingested. Animal studies have shown liver and kidney injury, with toxicity proportional to solubility.

Inhalation - Exposure to the airborne vapors should not exceed one part per million parts of air at any time.

Personnel Protection: Wear rubber gloves, lab coat, and face shield.

Spill Control: Eliminate all sources of ignition and flammable. Absorb spill on paper towels. Evaporate to dryness in a fume hood.

## TETRAFLUOROETHYLENE

Chemical Formula:  $\text{CF}_2:\text{CF}_2$

Synonyms: perfluoroethylene; TFE; teflon (resin); Fluon; "Halon"

Description: Colorless, flammable gas which when polymerized forms the plastic Teflon (polytetrafluoroethylene)

Fire Hazard: Flammable in a range of 10 to 50 percent. Vapor heavier than air. Use water to extinguish fires.

Toxicity: TFE is dangerous when heated to decomposition, emitting highly toxic fumes of fluorides. It has toxic properties comparable to the decomposition products resulting from heating Teflon above 400° C. Inhalation of TFE or the Teflon products causes symptoms defined as polymer fume fever, i.e., chills, fever, aches, and respiratory problems. Inhalation of TFE has also produced white blood cell disorders.

Personnel Protection: Ensure adequate ventilation and do not smoke when working with this gas. When gas concentrations occur in the work area, e.g., due to a leaking container, wear self-contained breathing apparatus.

Storage: Store containers in a well-ventilated area (preferably outside or detached storage) protected from direct sunlight. Separate from oxidizing materials.

Leak Control: Eliminate all sources of ignition. Place the leaking container in a fume hood or in an open area out-of-doors.

Chemical Incompatibility: Dangerous when reacted with sulfur trioxide or iodine pentafluoride and limonene. Halogenated compounds in general form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## TETRAHYDROFURAN

Chemical Formula:  $(CH_2)_4O$

Synonyms: cyclotetramethylene oxide; furanidine; oxacyclopentane; butylene oxide; 1,4-epoxybutane; oxolane; THF; tetramethylene oxide; diethylene oxide

Description: Colorless, mobile liquid with an ether-like odor

Fire Hazard: Flash point is  $-18^{\circ}C$  ( $1^{\circ}F$ ); explosive from 2.3 to 11.8 percent by volume in air. It forms thermally explosive peroxides on exposure to air. When heated to decomposition, it emits toxic fumes. Vapor is heavier than air. Extinguish fire with dry chemical,  $CO_2$  or foam.

Toxicity: It is a moderate health hazard, acting as a narcotic and irritant. Prolonged exposure results in injury to liver and kidneys.

Inhalation - Exposure to airborne vapors should not exceed 200 parts per million parts of air, (ppm) averaged over an 8-hour work period; 25,000 ppm will cause anesthesia.

Skin and eye contact - It is irritating to the eyes, skin, and mucous membrane.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush immediately with plenty of water for at least 15 minutes.

Skin - Wash with soap and water.

General - Treatment of exposure is non-specific.

Ingestion - If victim is conscious, have him drink water or milk.

Personnel Protection: Wear rubber gloves, lab coat, and face shield.

If containment and ventilation do not maintain vapor concentrations below safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill on paper towels. Evaporate to dryness in a fume hood.

Storage: Store in a cool, dark, well-ventilated area away from heat. It reacts with oxygen in the air within a matter of days to produce unstable peroxides. This reaction can be delayed by adding inhibitors, e.g., 1 percent ethyl alcohol. Outside or detached storage is preferable. Separate from oxidizing materials.

Chemical Incompatibility: Can form dangerous combinations with air, lithium aluminum hydride, potassium hydroxide, sodium aluminum hydride, or sodium hydroxide.

### 1,2,3,4-TETRAHYDRONAPHTHALINE

Chemical Formula:  $C_6H_2(CH_3)_2C_2H_4$

Synonyms: tetralin; tetraline; terranap; delta (5,7,9)-naphthantriene; tetranap

Description: A colorless liquid with a pungent, moldy odor.

Fire Hazard: A moderate fire hazard with a flash point of 77° C (171° F) and explosive limits from 0.8 to 5 percent by volume in air. Extinguish with foam, dry chemical, or CO<sub>2</sub>. Water may be ineffective.

Toxicity: It is a moderate irritant, ingestion, and inhalation hazard. In high doses it acts as a narcotic, and can produce kidney injury. In test animals eye cataracts have occurred.

Inhalation - The suggested upper limit to exposure to airborne vapors is 25 parts per million parts of air (ppm) averaged over an eight hour work period. Exposure of guinea pigs to 275 ppm, 8 hours a day for three weeks resulted in severe changes to the kidneys and liver. High concentrations also irritate the eyes and mucous membrane, and cause conjunctivitis.

Ingestion - It has moderate toxicity effects when swallowed; all effects are not yet known, but it is harmful.

Skin - Contact with the skin is irritating and can cause dermatitis and eczema.

Treatment of Overexposure: Contact Medical Service immediately.

NOTE: Sections marked (\*) below are for the attention of medical personnel and are not for first aid action.

Eyes - Flush the eyes with plenty of water.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*General - Further treatment, including blood transfusion and oxygen therapy, are indicated by symptoms.

Personnel Protection: Wear rubber gloves, lab coat, and chemical goggles or face shield. If vapors cannot be maintained within safe limits by containment and ventilation, e.g., during clean-up of a spill, wear self-contained breathing apparatus.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill with paper towels. Evaporate to dryness in a fume hood.

## THIONYL CHLORIDE

Chemical Formula:  $\text{SOCl}_2$

Synonyms: sulfurous oxychloride; sulfur oxychloride

Description: A colorless to pale yellow to red liquid with a sharp pungent, suffocating odor. It will decompose above  $140^\circ \text{C}$  ( $284^\circ \text{F}$ ) to form chlorine, sulfur dioxide and sulfur monochloride. It hydrolyses by water to form sulfur dioxide and hydrochloric acid.

Fire Hazard: Nonflammable. Decomposes when heated or upon application of water to form  $\text{SO}_2$  and  $\text{S}_2\text{Cl}_2$ .

Toxicity: Thionyl chloride is more toxic than sulfur dioxide. 17.5 parts of its vapor per million parts of air (ppm) was lethal to cats after 20 minutes of exposure. The suggested upper limit to exposure for airborne vapor is one ppm at any time. It is corrosive on contact, and is highly toxic by ingestion, inhalation, and skin and eye contact.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel and are included here for information only, not for first aid action.

Eyes - Immediately flush with plenty of water for 15 minutes.

Skin - Wash with plenty of soap and water.

\*Treat skin burns as usual.

\*General - For inhalation exposure administer oxygen with intermittent positive pressure. Also, a five percent solution of sodium bicarbonate may be used in aerosol form. Administer bronchodilators and decongestants as necessary. Further treatment is supportive and symptomatic.

Personnel Protection: Wear rubber gloves and protective clothing, and chemical goggles. Work in a fume hood or in an open area outdoors. If vapors may exceed safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Cover with dry vermiculite, sodium bicarbonate, or a mixture of soda ash and slaked lime (50-50). Mix and spray water cautiously from an atomizer. Beware of flash fire. Scoop up and add slowly to a large container of water (if too active continue spraying). When reaction is complete, neutralize (litmus test) with 6M- $\text{NH}_4\text{OH}$  or 6M-HCl and wash down the drain with a large excess of water. Wash spill site with soap solution.

Chemical Incompatibility: Dangerous when reacted with dimethyl sulfoxide, o-nitrobenzoylacetic acid, o-nitrophenylacetic acid, or water.



## TITANIUM TETRACHLORIDE

Chemical Formula:  $\text{TiCl}_4$

Synonyms: Titanic chloride; titanium chloride

Description: A colorless to light-yellow liquid which fumes in moist air forming a dense and persistent white cloud. It has been used as a smoke generator. It has an irritating odor.

Fire Hazard: Nonflammable. Do not use water to extinguish nearby fires. It reacts with water violently to produce dense toxic fumes.

Toxicity: The vapors are highly toxic by inhalation or contact with skin or eyes and the liquid moderately toxic by ingestion or by absorption through the skin. It acts as a strong corrosive.

Inhalation - The vapors are irritating when breathed and can cause bronchitis, lung edema, physical collapse, and death.

Ingestion - It has been estimated that one gram can be lethal.

Skin and eye contact - Contact of the liquid or vapor with the skin can produce skin burns; eye contact can produce conjunctivitis, and injury to the cornea.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not intended for first aid action.

Eyes - Flush with water for at least 15 minutes.

Skin - If the liquid is spilled on the skin, wipe it off with a dry cloth or paper towel before applying water. Then wash with plenty of soap and water. Remove contaminated clothing and shoes.

\*Treat skin burns in the usual manner.

\*Inhalation - Administer oxygen therapy by intermittent positive pressure method if necessary. Decongestants and bronchodilators have been useful.

\*General - Further treatment is supportive and symptomatic.

\*Ingestion - Have victim drink water or milk and induce vomiting.

Personnel Protection: Avoid contact with liquid and vapor. Where possible handle in a fume hood. If vapors exceed safe levels, e.g., during clean-up of a spill, wear chemical goggles, rubber protective clothing and self-contained breathing apparatus.

Storage: Keep container tightly closed.

Spill Control: Cover spill with excess sodium bicarbonate. If a small quantity is involved, scoop the mixture into a large beaker of water and let stand for a few minutes. Slowly pour into a drain with large amounts of water. Wash the spill site with soapy water.

Disposal: Hose away in an approved disposal pit.

## TOLUENE

Chemical Formula:  $C_6H_5CH_3$

Synonyms: phenylmethane; toluol; methyl benzene; methacide; methyl benzol

Description: A colorless clear flammable liquid distillate from coal tar, sometimes contaminated with benzene. Pleasant odor. Vapor is heavier than air.

Fire Hazard: Flammable. Flash point is  $4^{\circ}C$  ( $40^{\circ}F$ ); explosive from 1.2 to 7.1 percent by volume. Extinguish fire with dry chemical, foam, or  $CO_2$ . Water may be ineffective.

Toxicity: This volatile solvent is toxic by all portals of entry; inhalation, ingestion, and skin contact. Inhalation is usually the primary portal. In high concentrations toluene acts as a powerful narcotic and can cause coma, arrest of respiration, and death. Poisoning can cause liver damage. High concentrations can produce brain damage.

Inhalation - Exposure to airborne vapors should not exceed 200 parts per million parts of air (ppm) averaged over the eight-hour work period, nor 300 ppm at any time - except that 500 ppm is permitted for not more than a ten-minute period during the eight hours. Toluene can be detected by odor at about 200 ppm but loss of sense of smell follows rapidly at this level and cannot be relied on as a warning. 8000 to 12,000 ppm is believed to be hazardous to health.

Skin and eye contact - Contact with the eyes causes severe pain and intense burning of the cornea if not flushed quickly with water. Continued skin contact produces dermatitis due to de-fatting action.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes - Immediately flush with plenty of water and continue for at least 15 minutes.

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer saline cathartics and demulcents. Do not induce vomiting.

\*General - Recovery following removal from exposure is generally the rule and no permanent effects result. Further treatment is symptomatic and supportive.

Personnel Protection: Maintain work atmosphere below safe levels by process enclosure and ventilation. Wear rubber gloves, lab coat, and chemical goggles or face shield. If vapors should exceed safe levels, e.g., during clean-up of a spill, wear self-contained breathing apparatus.

Storage: Store in standard flammable liquids storage room.

Spill Control: Eliminate all sources of ignition and flammables. Absorb spill on paper towels. Evaporate to dryness in fume hood.

Chemical Incompatibility: Dangerous when combined with nitric acid and sulfuric acid, with nitrogen tetroxide, or silver perchlorate. Aromatic hydrocarbons in general can form unsafe combinations with inorganic acids, halogens, and molten sulfur.

## TRIBROMOMETHANE

Chemical Formula:  $\text{CHBr}_3$

Synonyms: bromoform; methenyl tribromide

Description: A heavy colorless liquid having a sweet odor; hexagonal crystals. Turns yellow with gradual decomposition.

Fire Hazard: When heated to decomposition it emits highly toxic fumes. Nonflammable.

Toxicity: Tribromomethane acts as a poison when inhaled, swallowed, or absorbed through the skin. It is an irritant, depresses the central nervous system, can damage the liver to a serious degree and can cause death through anesthesia. It is rather highly toxic and should be handled with a great deal of caution.

Inhalation - It has anesthetic properties similar to chloroform. It produces irritation, tearing of the eyes, and narcosis. Lung edema can result.

Ingestion - Taken orally, it is a poison which leads to respiratory difficulties and loss of consciousness.

Skin - Tribromomethane may be absorbed in toxic amounts through the intact skin. It is irritating to the skin and eyes.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) below are for the attention of medical personnel and are not for first aid.

Eyes - Flush with plenty of water

Skin - Wash with soap and water

\*Ingestion - Gastric lavage, followed by cathartics or enemas

Inhalation - Artificial respiration and oxygen, if necessary.

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses. If vapors could exceed safe limits, e.g., during clean-up of a spill, wear the appropriate chemical cartridge mask or a self-contained breathing apparatus.

Storage: Store away from light and direct sunlight. Keep containers tightly closed.

Spill Control: Absorb the spill with paper towels and evaporate to dryness in a fume hood. Wash the spill site with soap solution.

## TRIBUTYL PHOSPHATE

Chemical Formula:  $(C_4H_9O)_3PO$

Synonyms: celluphos 4; TBP

Description: A colorless, odorless liquid.

Fire Hazard: Combustible; flash point 146° C. Extinguish fires with water, foam, dry chemical, or CO<sub>2</sub>.

Toxicity: It is moderately toxic by ingestion and inhalation and also is a skin irritant. It stimulates the central nervous system and can result in death due to pulmonary edema.

Inhalation - Exposure to the vapors should not exceed five milligrams per cubic meter of air averaged over an eight-hour work period.

Contact Medical Services immediately if overexposure by any route is suspected.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. If vapors could exceed safe levels, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Absorb spill with vermiculite or paper towels. Scoop the mixture into a plastic bag. Burn with waste flammable solvent at an approved disposal site.

## 1,1,1-TRICHLOROETHANE

Chemical Formula:  $\text{CH}_3\text{CCl}_3$

Synonyms: alpha-trichloroethane; methyl chloroform; Chlorothene; NA500; ANE Chlorten; Aerothene TT; ethylidene chloride

Description: A colorless liquid which will not sustain combustion. It is volatile and has a chloroform-like odor detectable at from 20 to 100 ppm.

Fire Hazard: Relatively nonflammable; moderately flammable at higher temperatures. Ignition temperature  $537^\circ\text{C}$  ( $998^\circ\text{F}$ ). Emits highly toxic and irritating fumes when heated. Extinguish fires with dry chemical,  $\text{CO}_2$ , or foam.

Toxicity: Acts as a narcotic when inhaled or ingested in large doses, but the oral toxicity is quite low. Has damaging effect on liver.

Inhalation - Exposure to the vapors should not exceed a suggested limit of 350 parts per million parts of air (ppm) averaged over an 8-hour work period. A sweet odor is noticed at less than 350 ppm, which becomes disagreeable above 1000 ppm; 2000 ppm will be narcotic within 5 minutes. Death can occur due to heart or respiratory failure.

Ingestion - Oral toxicity is low.

Skin and eye contact - Prolonged contact with the skin causes mild dermatitis. Contact of the liquid or vapor with the eyes is irritating. Trichloroethane is poorly absorbed through the skin.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked (\*) are for the attention of medical personnel, and are included here for information only, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Do not administer epinephrine. See general comments below. If victim is conscious have him drink water or milk and induce vomiting.

\*General - Artificial respiration and oxygen, if necessary; keep warm and quiet.

\*Subsequent treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, lab coat, and safety glasses. General ventilation is usually sufficient to maintain vapor levels below safe limits at room temperature unless large areas of surface are wetted. If vapor levels are high, wear chemical goggles and an approved chemical cartridge respirator.

Storage: Do not store in aluminum containers.

Spill Control: Absorb on paper towels and evaporate to dryness in the fume hood. Wash spill site with soap solution.

Chemical Incompatibility: Forms dangerous combinations with acetone, oxygen, sodium, sodium hydroxide, sodium-potassium alloy, or aluminum. Halogenated compounds can form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## TRICHLOROETHYLENE

Chemical Formula:  $\text{CHCl} = \text{CCl}_2$

Synonyms: acetylene trichloride; algylen; ethynyl trichloride; chlorylene; ethylene trichloride; trichloren; trichloroethane; germalgene; trilene; T-403; Triline; Trethylene; Chlorylen; Trimar; Westrosol; triclene

Description: A clear, colorless liquid with sweet solventy odor barely perceptible at 20 to 100 ppm.

Fire Hazard: Nonflammable at ordinary temperatures. High temperatures may result in decomposition with toxic and corrosive fumes, including phosgene. Extinguish fire with dry chemical,  $\text{CO}_2$ , or foam.

Toxicity: Health problems can result from direct contact, inhalation of vapors, or ingestion. Prolonged overexposure can cause damage to the nervous system, the liver, kidneys, and the optic nerve. It may be habit forming (addictive). It has been known to produce liver cancer in test animals.

Inhalation - The most important effect is depression of the nervous system and narcosis. High concentrations can cause death. Exposures to vapors should not exceed 100 parts per million parts of air (ppm) averaged over an eight-hour work period, nor 200 ppm at any time - except that 300 ppm is permitted for not more than a five minute period in any two hours during the eight-hour period.

Ingestion - Swallowing small quantities can cause stomach and intestinal upset in addition to the long-term effects described above.

Skin and eye contact - Repeated skin contact can cause dermatitis due to the de-fatting action. Contact with the eyes is irritating. Some absorption through the skin can occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Items marked (\*) are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water

Skin - Wash with soap and water. Remove contaminated clothing and shoes.

\*Ingestion - Administer gastric lavage followed by saline catharsis.

\*Inhalation - Oxygen and artificial respiration if indicated.

\*General - No adrenaline; symptomatic and supportive. Follow liver and kidney functions carefully, and be alert for cardiac arrhythmia if anesthetic effects are noted.



Personnel Protection: Wear polyvinyl gloves, lab coat, and chemical goggles. If local exhaust ventilation and containment do not keep vapors below safe levels, e.g., during a spill, wear a self-contained breathing apparatus.

Storage: Store in well-ventilated, cool location out of direct sunlight.

Spill Control: Absorb on paper towels and evaporate to dryness in a fume hood. Wash spill site with soap solution.

Chemical Incompatibility: Can react dangerously with aluminum, barium, nitrogen tetroxide, lithium, magnesium, liquid oxygen, oxygen, potassium hydroxide, potassium nitrate, sodium, sodium hydroxide, and titanium. Halogenated compounds in general form unsafe combinations with inorganic acids, caustics, amines, olefins, esters, and cyanohydrins.

## TRIETHANOLAMINE

Chemical Formula:  $(\text{CH}_2\text{OHCH}_2)_3\text{N}$

Synonyms: 2-aminoethanol; tri (hydroxyethyl) amine; trolamine; sterolamine; 2,2',2''-nitrilotriethanol; daltogen, triethylolamine; trihydroxytriethylamine

Description: A pale yellow oily liquid with mild ammonia odor. Becomes brown on exposure to air or light.

Fire Hazard: Combustible. Flash point 179° C (355° F). Toxic gases may be produced in fire. Extinguish fire with dry chemical, alcohol foam, or  $\text{CO}_2$ . Water may be ineffective on fire.

Toxicity: A slight ingestion and skin absorption toxic hazard. It can produce liver and kidney damage under prolonged exposure.

Inhalation - No threshold limit has been established. Animals exposed to 100 parts of vapor per million parts of air (ppm) have died after 30 days of exposure. The level of detectable odor is 3 to 4 ppm. Skin irritation and lethargy have occurred at 5-12 ppm.

Eye contact - The liquid splashed in the eyes can cause severe injury.

Ingestion - The amount that might prove to be lethal, if swallowed, is believed to be from one pint to one quart. G.I. tract damage would result.

Treatment of Overexposure: Contact Medical Services immediately.

Eyes - Flush with running water for at least 15 minutes.

Skin - Wash with soap and water

Ingestion and inhalation - Treatment is supportive and symptomatic. If the victim is conscious and swallowed this material, have him drink water or milk.

Personnel Protection: Wear butyl gloves, chemical goggles, and lab coat. If vapors are not maintained below safe limits, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Cover spill with sodium bisulfate. Spray with water, and wash down the drain with a large excess of water.

Chemical Incompatibility: Amines in general can form unsafe combinations with inorganic acids, organic acids, halogenated compounds, aldehydes, ketones, esters, phenols, cyanohydrins, nitriles, and acid anhydrides.

## VANADIUM PENTOXIDE

Chemical Formula:  $V_2O_5$

Synonym: Vanadium anhydride; vanadic anhydride

Description: A yellow to red crystalline powder

Toxicity:  $V_2O_5$  presents low toxicity by ingestion and skin contact and intermediate toxicity by inhalation.

Inhalation - Exposure to airborne dust concentrations should not exceed 0.5 milligram per cubic meter of air averaged over an eight hour work period. The limit for fumes is  $0.1 \text{ mg/m}^3$ . Toxic effects include chronic cough, chest pain, bronchitis, and emphysema.

Skin and eye contact - It irritates the conjunctiva of the eye on contact but generally is not irritating to the skin. It can penetrate the intact skin and be absorbed into the bloodstream.

Ingestion - Acute poisoning results in gastrointestinal upset, loss of appetite, emaciation, and blood disorders. 60-100 milligrams may cause death.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections below marked with (\*) are for the attention of medical personnel and are included here only for information, not for first aid action.

Eyes - Flush with water

Skin - Wash with soap and water

\*Ingestion - Administer gastric lavage followed by saline catharsis; give ascorbic acid at 100 mg three times a day. Further treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, chemical goggles, and lab coat. If vapors may exceed safe levels in the work area, e.g., during clean-up of a spill, wear a self-contained breathing apparatus.

Spill Control: Cover the spill with powdered ammonium carbonate. Add a layer of crushed ice and spray with  $6M-NH_4OH$  while stirring. Scoop the slurry into a leak-tight container and save for salvage if desired. Wash the site with soapy water.

Chemical Incompatibility: Forms unsafe combinations with chlorine trifluoride and with lithium.

## XYLENE

Chemical Formula:  $C_6H_4(CH_3)_2$

Synonyms: xylol; dimethylbenzene

Description: A clear, colorless, volatile, flammable, liquid solvent with a sweet odor. Commercial xylol is a mixture of three isomers; ortho-, and para-xylene, with the meta-form as the major component.

Fire Hazard: High. Flash point and explosive range varies with the isomer, but all have flash points near room temperature and explosive limits ranging from 1 to 6 percent by volume in air. Vapors are heavier than air. Extinguish fire with foam, dry chemical, or  $CO_2$ . Water may be ineffective on fire but may be used to reduce the rate of burning.

Toxicity: Moderate health hazard, being toxic by inhalation, ingestion, and by skin absorption. It is narcotic, depresses the central nervous system, and is an irritant.

Inhalation - Exposure to airborne vapors should not exceed 100 parts per million parts of air (ppm) averaged over an eight-hour work period. 200 ppm can be detected by odor but higher concentrations tend to paralyze the sense of smell and so odor is not a safe means of detection. Xylene is narcotic at 2300 to 3500 ppm. It is irritating to the nose and pulmonary system and can cause lung edema. Concentrations greater than 3500 ppm may be lethal.

Ingestion - No fatal cases reported, but fatalities are possible.

Eyes and skin - Toxic poisoning by absorption through the skin is slow. Defatting action produces dermatitis, it is an eye irritant, and lesions in the cornea may occur.

Treatment of Overexposure: Contact Medical Services immediately.

NOTE: Sections marked with (\*) are for the attention of medical personnel and are not first aid action items.

Eyes - Flush with water. \*Administer analgesic ointment.

Skin - Wash with soap and water

\*Ingestion - Gastric lavage with warm water followed by 1-2 ounces of mineral oil and saline cathartic. Do not induce vomiting.

\*General - Artificial respiration and oxygen, if necessary. Do not administer epinephrine and avoid digestible fats, oils, or alcohol. Subsequent treatment is symptomatic and supportive.

Personnel Protection: Local exhaust ventilation or containment should be used to keep concentration of vapors within safe levels. When vapors exceed this, e.g., during a spill, wear an organic vapor canister mask or self-contained breathing apparatus. Wear rubber gloves, lab coat, and chemical goggles.

Storage: Outdoors or detached storage is preferable. Indoors storage should be in a standard flammable liquid storage room.

Spill Control: Eliminate all sources of ignition and flammables. Absorb the spill with paper towels, and evaporate to dryness in a fume hood.

Chemical Incompatibility: Aromatic hydrocarbons in general form unsafe combinations with inorganic acids, halogens, and molten sulfur.

## ZIRCONIUM OXIDE

Chemical Formula:  $\text{ZrO}_2$

Synonyms: zirconia; zirconium dioxide; zirconic anhydride

Description: White crystals

Toxicity: Inhalation is the main route of entry to the body. It acts primarily as an irritant.

Inhalation - Exposure to airborne fume should not exceed 5 milligrams per cubic meter of air averaged over an eight-hour work period. The recommended limit for ultrafine powder is  $0.1 \text{ mg/m}^3$ . It appears to act as a systemic poison on the central nervous system with resultant progressive depression. Mild respiratory irritation also occurs.

Skin - Skin contact in sensitized persons can produce dermatitis and granuloma of the skin.

Treatment of Overexposure: Contact Medical Services. Treatment is symptomatic and supportive.

Personnel Protection: Wear rubber gloves, safety glasses, and lab coat. When airborne dust concentration may exceed safe levels, wear approved mechanical filter respirator.

Spill Control: Collect spill in a beaker, dissolve in a large amount of water, add soda ash, mix, neutralize with 6M-HCl and wash down the drain with an excess of water.

## ZIRCONIUM POWDER OR DUST

Chemical Formula: Zr

Description: A bluish-black amorphous powder, or white-gray solid

Fire Hazard: Zirconium in powder form is an extremely reactive metal which can explode spontaneously with great violence if particles are less than 10 microns in size. It ignites with relative ease and has a high rate of energy release, particularly when moist with water content of 5 to 10 percent. Fires involving zirconium cannot be extinguished by ordinary means and requires smothering by pulverized mineral material, e.g., dolomite, or graphite-type (G-1 powder) or salt-resin base (Met-L-X) agents.

Toxicity: Zirconium powder has a mild toxic action through inhalation or by skin contact, and is considered to be an inert nuisance dust with low health hazard.

Inhalation - It acts as a respiratory irritant. Exposure to airborne dust should not exceed 5 milligrams per cubic meter of air averaged over an eight-hour work period. No cases of industrial poisoning as a result of inhalation have been reported.

Skin contact - Prolonged contact with the skin causes dermatitis and the formation of granulomas in the skin.

Treatment of Overexposure: Contact Medical Services

Eyes - Flush with plenty of water for 15 minutes.

Skin - Wash with soap and water

Inhalation - Physician referral with treatment being symptomatic and supportive

Personnel Protection: Wear leather gloves, safety goggles or face shield, and fire-resistant clothing without pockets, cuffs or other recesses.

Storage: The fine powder can be stored completely immersed in water, or under dry argon. Isolate from oxidizing materials.

Operating Controls and Disposal: Control dust production with water-wash dust collector. Machine in the dry state or with the use of high-flash neutral mineral oil coolant. Place chips in covered metal waste cans and remove to disposal daily. Scrap zirconium should be burned at an approved disposal site.

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